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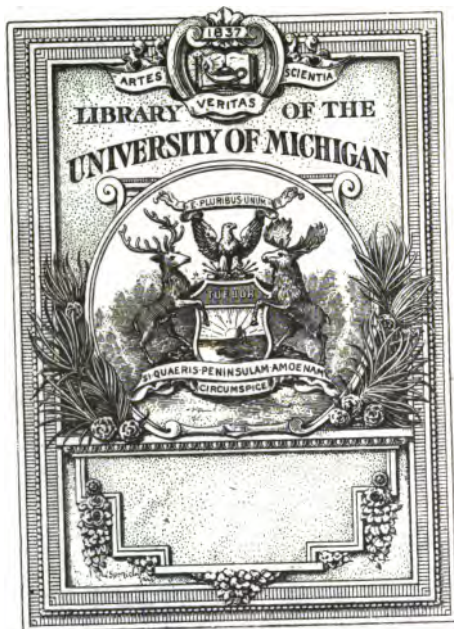
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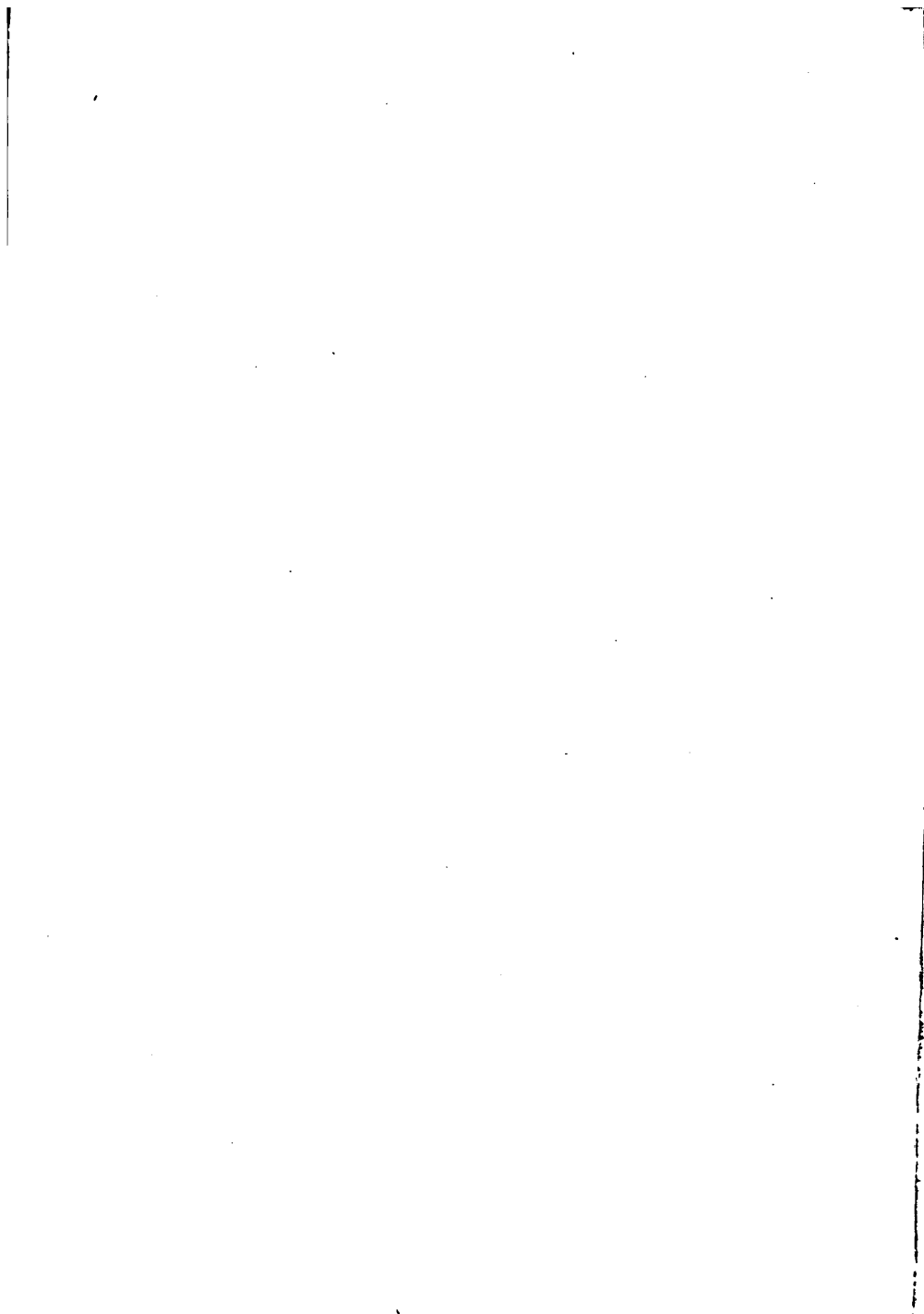
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1911

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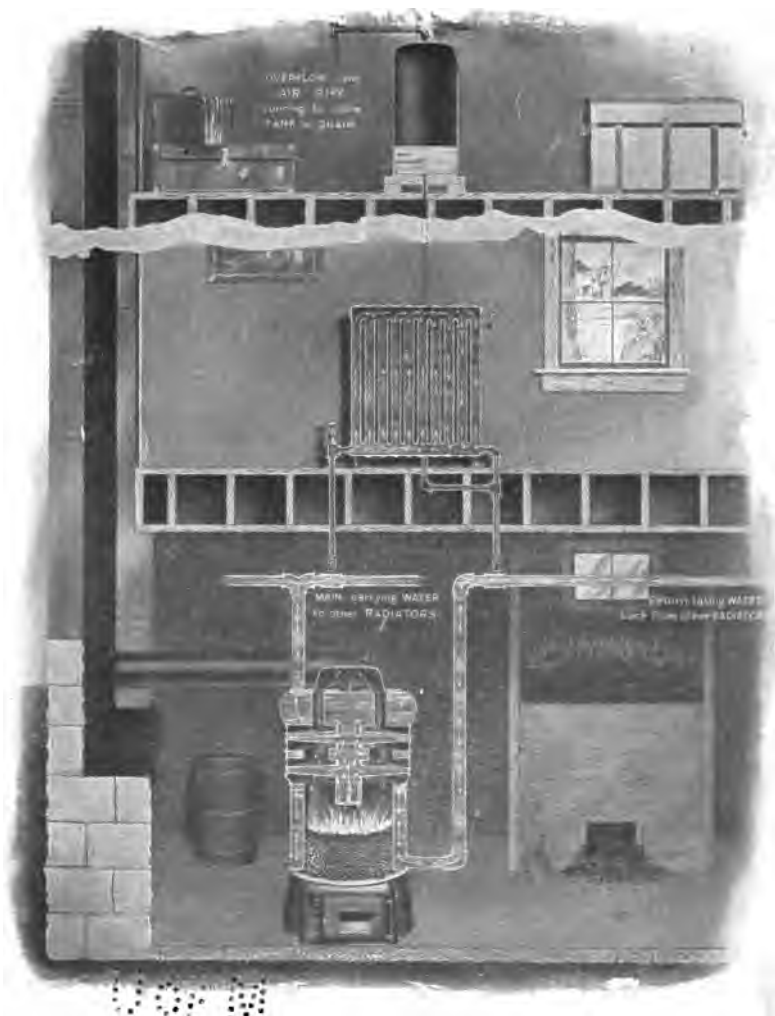
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HOT WATER HEATING SYSTEM, SHOWING CIRCULATION AND EXPANSION TANK

Household Hygiene

BY

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AND CLEANING"**



CHICAGO

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1911

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AMERICAN SCHOOL OF HOME ECONOMICS
CHICAGO

January 1, 1907.

My dear Madam:

The human voice has great influence, therefore the spoken word, through emphasis and intonation is an important factor in the success of a teacher. It may increase or decrease his efficiency according as it attracts or repels the pupil.

Between us there will be opportunity neither for the one or the other. We shall have to depend upon the written word alone.

In order that the following pages may hold the most value for each of us there must be first, a thorough mental grasp of the facts stated.

Second, this should be followed by either one of two experiences—an immediate application to personal conditions. Whenever possible this is the better way. Or, if this is not feasible, the observation of such application elsewhere.

Look at houses, their furnishings, equipment, methods of care; note what is objectionable about any or all of these. Imagine how you would remove these objectionable conditions, were it possible. In your own home do it whenever possible.

After which, write freely concerning the subjects touched upon in the questions. Give the answers in your own words. Use illustrations of any kind which may make the meaning clearer. Do not be afraid of telling too much. If it is pertinent to the question, it is desirable. If it helps me seize your point of view, it is worth while.

In questions of opinion, do not be afraid to disagree with the one suggested. Give from your experience any hints which may be helpful to others. In short, make the answering of the tests more nearly a true recitation than a mere examination.

Then make use of the school and the instructor wherever they can serve you the best. In this way we shall both accomplish most in this correspondence method of study.

Yours sincerely,

S. Maria Elliott.

Instructor

HOUSEHOLD HYGIENE

HEALTH is the birthright of every individual born into the world. "That bit of something warm done up in flannel," as a human baby has been called, begins its life as a living machine. No individual can choose the heritage with which he starts, but each soon becomes responsible for keeping what is good, for the partial conquest over defects and, in great measure, for the health of others. These responsibilities necessitate a knowledge of the requirements of health and of all healthful conditions. The environment of each individual may make or mar his efficiency.

Air, light, water, and food are the great four primary needs in the life of man as in that of his animal and plant relatives. These, too, must be in sufficient quantity and of good quality.

**Primary
Needs of
Mankind**

Civilized man protects his body with clothing and then shuts himself inside a house. The latter he wants warmed, and lighted at night that he may comfortably prolong his hours of work or pleasure. Into this shelter he chooses to bring supplies of food and furnishings to make life possible and profitable.

All this seems very natural and simple, but wherever there is life there is death, and the wastes from man's processes of life and living are his worst enemies.

Dangers

These must be removed promptly and to a safe distance; or he must take himself away from them, as primitive man did.

In life under simple and isolated conditions each house may be considered alone, but where men congregate dangers increase and all must co-operate for the common good.

**Public
Sanitation**

In cities and large towns the common requirements are largely under public control, and responsibility is delegated to official boards of health; while in smaller places the physicians often combine such sanitary supervision with their other duties. They realize, if others do not, that "Prevention is better than cure."

Public or municipal sanitation has improved of late years. Since the discoveries of science have shown that many of the fatal diseases of mankind are preventable, wise laws have been enacted and violations of these laws made subject to punishment.

**Accumulative
Effect of
Unsanitary
Conditions**

Usually the effects of unsanitary conditions are not immediately apparent. The weakened constitution, lack of energy, the tendencies or predisposition to certain diseases which are the immediate effects are so subtle that they are unnoticed. When, some time after, perhaps even in the next or following generations, fatal disease appears, it is usually attributed to a near cause, not traced back through the accumulation of causes, among which unsanitary housing may have been the most powerful as well as the most insidious. To the sanitarian the histories of families

living in certain sections most forcibly suggest why tuberculosis is now responsible for one-tenth of the deaths in the United States.

The science of bacteriology has laid the foundation of sanitary conditions and leads to a correct understanding of the preventive measures which tend toward health.

Because woman spends most of her time within the house, because she is the acknowledged and responsible director of that house; above all, because she is the *mother* of the race, should she understand what health conditions are and how they can best be obtained.

It has been stated by authorities in sanitary science that there is little use to legislate further concerning public sanitation until the ideal of the individual housewife raises the standard of the private house.

Ideals

Given a community of sanitary homes, the sanitary office and school house will follow.

Conditions harmful to man's health and efficiency are not only harmful to his life but also to that of his possessions, therefore economy as well as health requires that the house and all it shelters receive intelligent oversight and care.

To point out the relations of the house and its contents to man's requirements, that all may be made to increase rather than decrease his efficiency is the purpose of Household Hygiene.

GENERAL SITUATION

Location

Few of us are so fortunate as to live in a house built for us. The many have to live in houses or apartments built for no one in particular, and to make them into homes. In any case, location is the first thing to be considered. The character of the neighborhood; nearness to business, schools, churches or social centers; the means and cost of conveyance thereto are all determining factors in the selection, but from the health standpoint, air and sunlight are to be chiefly considered. In general, *Dampness*, *Darkness* and *Dirt* may be looked upon as the modern *Fates*. When these are constantly present, the thread of life will as surely be snipped in two as if Atropos the Inevitable held the shears.

Sun-dried Air

Ideally every house should have an entire daily bath of sun-dried air—air which has been acted upon and possibly sterilized by the sun's rays.

In city blocks shadowed by large buildings this is impossible.

Buildings too near together, high and close-foliaged trees in large numbers, or sometimes high hills either keep off much air or interfere with the circulation which would keep it pure. Air in spaces too narrow or wrongly situated to admit direct sunshine is less healthful than that through which the sun has penetrated.

The strength and direction of the prevailing winds should be noted. In general, on the Atlantic coast,

northerly winds are cold and dry, while those from the south are warm and moist. The presence of large bodies of water may alter both conditions. The influence of climate upon individual health is a large physiological problem. Bleak winds sweeping across the top of a hill may make such a location too cold for health or economy, although they may ensure perfect purity of air. Winter temperatures and sunny exposure must be considered in relation to both the body and the bank account.

Whether the proximity of bodies of deep and clean water is healthful or not depends chiefly upon the air circulation. If this is sufficient to prevent fogs or excessive dampness, and the shore is free from decaying organic matter, either animal or vegetable, the influences will be healthful, and such situations are usually warmer in winter and cooler in summer.

Not only should there be a free circulation of air, but there should be no near conditions which might render the air impure, such as stagnant water, which furnishes breeding places for mosquitoes, and may therefore be malarial; decaying vegetation, as in swamps; reaches of barren sand to furnish irritating dust; or factories pouring out smoke or offensive gases. Winds often carry objectionable odors and solid particles for considerable distances.

The choice of a location may depend also upon a good water supply, but this will be discussed later.

It is obvious that as present constituted, the whole

**Proximity
of Bodies
of Water**

human family cannot live in ideal spots, but in the majority of cases, ignorance, or mistaken economy rather than necessity stands in the way.

GROUND AIR

That our earth is bathed in an ocean of air which we call the atmosphere, is a familiar fact, but another condition equally true is little realized.

How the
Ground
"Breathes"

If we put into a tumbler all the beans or small pebbles it will hold we say it is full, and so it is, but not with beans or pebbles, as may be proved. If we pour water slowly on the surface, we shall see bubbles of air escaping and we may continue this until all the air has been displaced by the water. This displaced air we will call *ground air*.

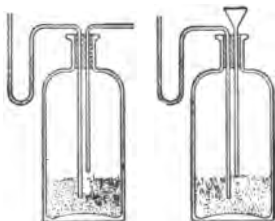


Fig. 1.

Fig. 2.

Fig. 1 is a bottle fitted by means of a perforated rubber stopple with two glass tubes, one of which holds in the bend, water colored with bluing.

One tube extends below the surface of a layer of common garden soil or loam. If we blow through the other tube we produce conditions over this bit of earth similar to those which exist out-of-doors when winds blow over the surface. That this pressure of the air over one part of the earth forces the ground

air upward in another part is shown by the change in the level of the water in the curved arm.

This illustrates how varying pressure on the surface may produce movements in the ground air. In a very real sense the ground "does breathe."

In Fig. 2 one tube is replaced by a funnel-shaped tube extending to the surface. Water may be poured into this and some of the air it displaces will be pressed upward and show its effects in the curved tube, as it did before. Rain falling upon the ground, by displacement, forces the ground air outward.

**Effect of
Rain Fall**

Winds, rain, snow, and growing vegetation are important agents in the purification of the atmosphere; but these have much less if any effect upon the ground air, while it is subject to great contamination by the gases from the decomposition of buried animal and vegetable matter, or by those escaping from sewer and illuminating gas-pipes. The ground air, therefore, must necessarily be impure and damper than the atmosphere.

SOIL AND THE SITE

In the uncounted ages the crust of the earth has been worn away by nature's agents into "rock ruins" which, becoming more and more finely divided, we recognize as gravel, sand and clay of varied composition. When conditions were favorable, living forms appeared, but in due time death followed. The organic remains of plant and animal life were then added

**Natural
Land**

to the inorganic rock debris, and so loam was formed. All of these make natural land.

**Made
Land**

Man sometimes wants land where there is or has been water. He therefore proceeds to fill the hollow, displacing the water and raising the level to that of the adjoining land. So long as he does this with clean gravel, sand, ashes, or other mineral matter and allows time for settling, there is no objection to using "made land" for dwelling sites; but, too often, such places, especially in cities, are filled with house refuse—tin cans, garbage, all manner of decomposable material. This is very objectionable.

The Site

The site, or plot of land under a house, must be free from anything which would pollute the air about or in the house, either with gases or solid particles, visible or invisible.

It must also be dry, for it has aptly been said that houses should not have "wet feet."

First, then, all loam, *top soil*, must be removed from the site because it might contain disease germs or organic matter, which in decomposing would furnish unhealthful gases.

A dry site is dependent upon thorough drainage either natural or artificial. Natural drainage depends upon the character of the soil and its slope.

**Absorption
of Water**

We may think that rocks will not absorb water, but this is true to only a limited extent and varies much with different rocks. To show this, take any small stones that may be at hand. Perhaps pieces of gran-

ite, slate, sandstone, limestone, or marble will be most instructive. It may be interesting further on if we compare these with wood and brick. Dry all of these in an oven. Weigh each and record the weight. Immerse all in water for some hours, even over night. Remove and wipe lightly to free from surface water. Weigh each and compare this weight with the original record. The difference shows the amount of water absorbed. This will be found to be from one to twenty-five per cent.

If rocks absorb and hold moisture what about gravel, sand and other soils?

Take four ordinary tumblers, or any glass dish. Put into each the same quantity of gravel, sand, clay, and loam, leaving them about one-half full. Slowly pour on each an equal amount of water, perhaps one-quarter of a cupful, or more as convenient. Notice the rapidity with which the water sinks and whether the soil would take more or less before becoming saturated or "water-logged," as the gardener says.

**Experiments
with Soils**

The water will be seen to run rapidly through the gravel, more slowly through the sand; almost none at all through the clay unless there are cracks or holes where it stands or finds free passage, but it is absorbed and held very near the surface.

In this way can be seen which soils would hold water and which would let it run through or drain off. Water will, of course, run down hill faster than on a level, therefore a slope is necessary for efficient drainage.

GROUND WATER AND DAMPNES

All water comes primarily from above, but the rain falling on our little plot is not alone to be considered. That which fell long ago and at great distances may keep the house in a "wet-footed" condition.

In the tumblers of soil in the previous experiment, the water finally gathered at the bottom because the glass was impervious and would not let it through.

Ground
Water

The water which soaks into the soil finds similar impervious strata, sometimes as a level bed, sometimes a slope, often a bowl-shaped depression of rock or clay where it collects, or makes its slow way by regular or irregular flow toward the sea. This is *ground water* and the surface of this water is known as the water table of the region. The height of the water in a well shows the level of the ground water.

In Fig. 3 the underlying rock is seen at *a*; in all the depressions *c*, gravel saturated with the ground water; while over this is a layer of sand, *d*; with loam above as at *b*. The two houses with foundations of equal depth might be expected to be equally dry. However, the larger being over the height of rock and not over the ground water strata, would probably be much dryer.

Water
Table

The geological formation of any region governs the depth of the ground water and the height of this water table. Sometimes the water comes to the surface, making a permanent bog or swamp, or under pressure, it may give a spouting spring.

There are many ways in which the course of the ground water is interrupted or its level disturbed. The fluctuations thus brought about cause mysterious alternations of wet and dry conditions in the same plot of ground. It is therefore necessary to know something about the natural level of the ground water of a region before deciding upon the house site. A low ground water of uniform level is best, but between a

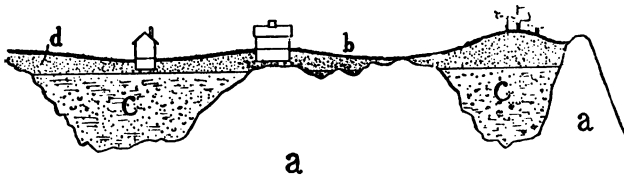


Fig. 8. Section of Ground Showing Possibilities of Dampness from Ground Water.

high uniform and a low fluctuating level, choice should fall upon the former.

Five feet is considered the least distance to intervene between the highest level and the bottom of the foundation of the house. Fifteen feet is none too much for safety.

This ground water is plainly seen to be separate from the soil moisture which comes from the tiny water envelope around each soil particle and to conserve which, for the life of vegetation, is the aim of the farmer.

Soil
Moisture

To remove a drop of ink we apply the corner of a piece of blotting paper. The ink gradually rises in the

paper by clinging to the minute fibres of which it is composed. Many substances, when in the presence of liquids, show this capillary action. Certain kinds of soil have strong capillary power and, because of it, water will rise in them to a considerable height. In this way a rise in ground water may cause damp soil for some distance above.

**Other
Causes of
Dampness**

A damp house is often caused by many near thick-foliaged trees which prevent the access of direct sunlight to all parts of roof, walls and foundation; which retain much moisture on their leaves after rain and prevent a free circulation of air around the house. This retards evaporation and consequent drying of the soil. Such conditions also tend to rapid deterioration of the house itself.

A few high trees are allowable to protect the roof from the excessive heat of the summer sun, while lower ones at a greater distance may furnish protection and not interfere with the daily sun and air-bath which every house needs.

Overhanging eaves or wide-roofed verandas sometimes shut out the life-giving sunshine and make certain rooms damp and unhealthful.

Too few windows or those wrongly placed may keep out the health-giving sunshine and air. Blinds kept closed for fear of faded furnishings, windows not opened sufficiently often or long enough to insure a complete change of air, shades drawn for similar reasons—all these conditions may tend to keep a house unhealthy because of darkness and dampness.

SITE DRAINAGE

The healthful site must therefore be not only of safe soil, but thoroughly drained from water, either by the natural soil and slope of the land, or by artificial means. A gravelly soil on a slope usually drains itself well, but more often it is necessary to supplement natural drainage by artificial drains. These may be of differ-

**Artificial
Drainage**

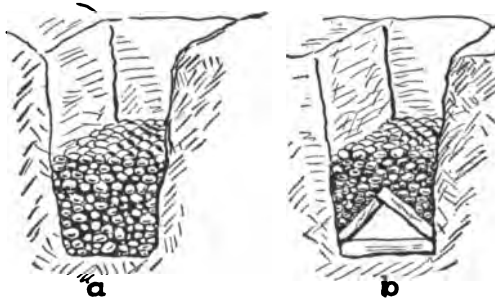


FIG. 4. STONE DRAINS.

- a. Common Loose Stone Drain.
b Stone and Triangular Board Drain.

ent kinds as suggested by Fig. 4, but the best and cheapest in the end is the agricultural drain tile. This is used for general land drainage and also for the especial drainage of the house site.

These tiles are made in different shapes of porous terra cotta. They are laid in short lengths with open joints, that is, the sections simply butt against each other without being joined with cement or mortar.

**Drain
Tiles**

Fig. 5 shows sections of house drain tiles. They

are about two feet long. Although the pipes are porous, most of the water enters at the open joints. A pipe of small diameter with many joints will drain a large area.

If the land adjoining is effectually drained, the site may not need a special system, but in most cases it is safer to have this.

Country Houses

Country houses often need to be drained for some distance back, while with city houses attention is generally paid to the site alone, because of the general municipal drains.

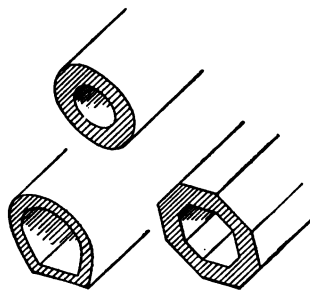


Fig. 5. Drain Tile.

Where a house stands near the bottom of a hill it may be necessary to have a cemented gutter along one, two or three sides to carry away the wash from severe show-

ers or spring freshets. This water should not be allowed to soak into the ground against the foundation unless this is absolutely damp-proof.

Drain Plans

The ditch holding the drain pipe may be dug in various directions according to conditions. It may be necessary to lay the drain only along those sides of the cellar from which water flows toward the house. Fig. 6 shows various ways of placing such drains.

If the ground be very damp, it may be necessary to make what is called a gridiron, Fig. 7.

In all cases the drains must incline toward the outlet that they may empty at a lower level than the cellar, and to prevent any danger of a back flow of water or soil. The outlet should be protected from the entrance of small animals. Rats sometimes make their way along these pipes, entering the building through holes gnawed by them or through the joints. In one instance, in the country, knowledge of a broken drain was gained by finding a skunk in the cellar.

Outlet
of Drain

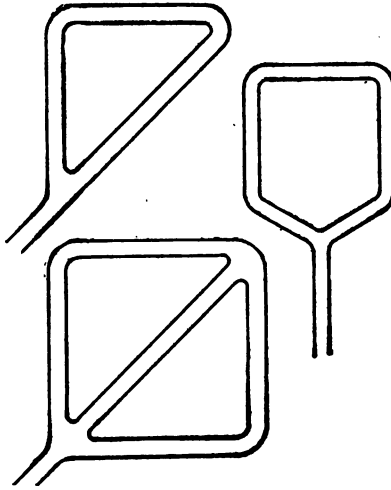


Fig. 6. Plans of Drainage Ditch for Site Drainage.

As these drains are for clear water only, not sewage, they may safely empty into a water course. Where there is a separate sewer for rain water, it may also receive that from land drainage.

THE CELLAR

The Box Above

A house may be considered a box, divided into many compartments, with great variety in their contents it is true, but a box still.

In the tropics the box is raised some feet above the ground and thereby thorough circulation insures greater coolness and freedom from ground air and dampness.

In some places a level surface is covered with a thick layer of concrete or cement, and the box is placed directly upon this impervious table.

The Hole in the Ground

Generally, however, the box or house is placed over a *hole in the ground*, which we call a cellar. The primary purposes of this hole are to insure dryness by separating the box above as much as possible from the ground with its attendant dangers of ground air and water, and to make the house warmer in winter and cooler in summer.

Cellar Under All the House

The hole should extend under the whole house but, if it cannot, then any other part of the house should stand on an impervious bed or be raised sufficiently to allow free air space between it and the ground. Summer houses, ells and porches are often raised in this way, the space left open or enclosed, possibly with lattice-work. Many a summer cottage lacks this open and sufficiently large space underneath to keep the ground dry and healthful, or to keep ground air out of the house.

A secondary purpose of the cellar is to furnish a place of storage. In the country now, as in the houses of the pioneer settlers, the cellar is the place where vegetables, meats and other food supplies are kept from freezing during the winter. At the same time they are easily accessible. Often the entire space outside between ground and first floor is banked with shavings or earth to make the house still warmer. This shuts out the little light which crept into the cellar before, and interferes with ventilation.

Bacteriology teaches us that under such conditions of darkness, moisture, and moderate warmth, decay will be carried on with great rapidity. The damp polluted air will rise readily through the porous wood floor above and mingle itself day and night with the air of the house.

Anyone who has once smelled the odor of rotting vegetables which too often comes from such a cellar, will not wonder that ill-health broods like a black cloud over the family.

It is better that large quantities of any perishable

**A Storage
Place**

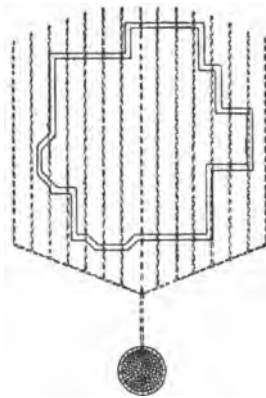


Fig. 7. "Gridiron" Site Drainage, Lines of Tile Laid Under the Entire Cellar Bottom.

**Dangers of
Cellar Air**

material be stored elsewhere than under the living place of human beings.

Dr. F. H. Hamilton says: "Mold and decaying vegetables in the cellar weave shrouds for the upper chambers."

That human beings can live without evident disease in spite of such conditions only emphasizes the health-giving qualities of sunshine, pure air and exercise. Those who live most of the time in the open air can withstand many adverse conditions.

Decay We have learned from Bacteriology that the soil teems with bacteria and that molds are ever ready in dark, damp places to unite with them in the process of decomposition. Where unprotected wood rests upon the ground it will be attacked and gradually decay. Metal will corrode under action of moisture and oxygen. Stone, as we have seen, is porous, will absorb moisture and therefore be subject to possible harm from frost.

**Cellar a
Reservoir
of Air**

Much of the air in the "box above" comes from the cellar. The sun shining on the roof heats the air at the top; heated air tends to rise; as this rises the colder air ascends from below, making a constant current from the cellar upward. This current is increased when artificial heat is added to that of the sun.

If coffee or other odorous substance is burned in a tightly closed cellar the odor is soon perceived in the upper rooms. Certain experiments made in Germany showed that one-half the cellar air made its way into

the rooms of the first story, one-third into the second and one-fifth into the third. This is suggestive of one reason why rooms on the ground floor are not best for sleeping purposes.

The cellar walls must form a firm foundation for the house above. For this stone serves best, but stone is somewhat porous, as we have seen.

**Foundation
Materials**

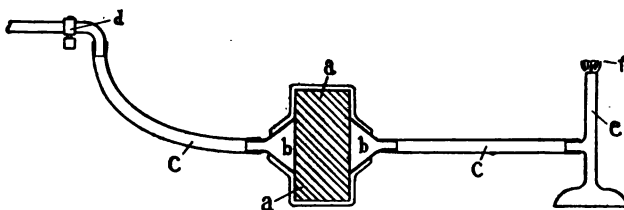


Fig. 8. Showing that brick is permeable to illuminating gas.

Ordinary bricks are not suitable for use next the ground, for they are very absorbent. From the experiment in weighing, suggested on page 9, we may find how much water brick will take up. Some varieties absorb as much as 25 per cent. of their weight. Glazed bricks are rendered non-absorbent so long as the glazing remains intact, but in time there is danger that substances in the soil may dissolve or crack the glaze.

Fig. 8 shows another way in which brick may be dangerous below the surface of the ground: *a* is a common brick covered all over with a thick layer of paraffin except at *b*, where two funnels are held tight-

**Brick
Pervious
to Gas**

ly against its sides. The funnels are secured to the sides by the paraffin, so that all possible cracks are stopped; *c* are rubber tubes over the funnel ends. One leads to the gas cock, another to a Bunsen burner. If the gas be turned on at *d* and a lighted match held at *e*, after a little while a tiny flame will be seen. The gas has no chance of reaching *e* except by passing through the brick from funnel to funnel.

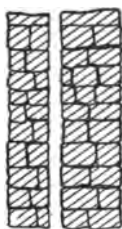


Fig. 9. Wall with Ventilation Space.

If illuminating gas will pass through brick, sewer and other gases, or air from decomposing matter may. Compact, close-grained stone like granite is best to use for foundation walls, although any firm stone may be used if properly prepared, leaving the more expensive granite for the portion showing above the ground.

Impervious Construction

Foundation walls, then, wherever they touch the soil should be made impervious. This is done in different ways. Sometimes the wall is made double, leaving an air space between for ventilation. For a dry site this will answer. Fig. 9. Sometimes hollow bricks are used in the outside courses for the same purpose.

Often a layer of impervious material—tarred paper, pitch, asphalt, lead, slate, etc.—is placed between the wall and the soil. This is known as a damp-proof course. It should extend under the foot, up the entire height, and better, across the top. Fig. 10.

The surface of the ground should slope away from the foundation. The stones should be laid in good

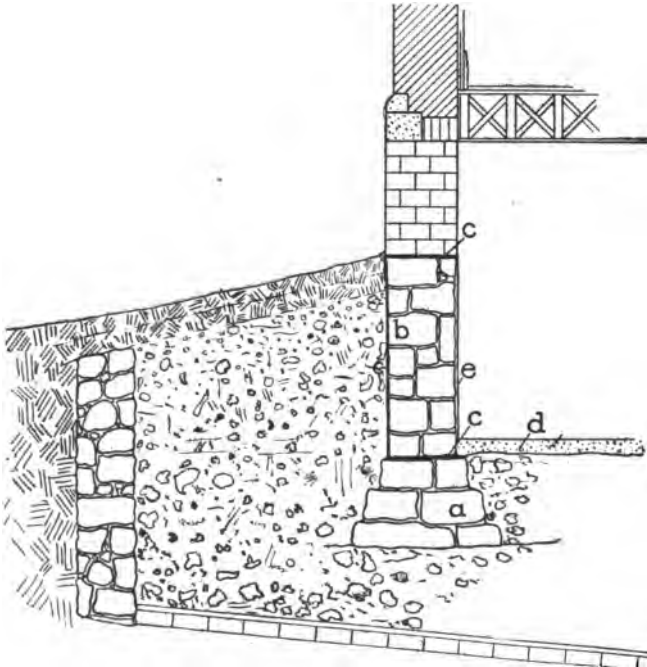


FIG. 10. SECTION SHOWING CONSTRUCTION OF CELLAR WALL AND POSITION OF PROTECTING "CUT-OFF" WALL FOR VERY DAMP PLACES.

- a. Footing or base of foundation. b. Foundation wall. c. Damp-proof course. d. Floor of asphalt between two layers of cement. e. Cement face of wall.

cement mortar, which is fairly impervious to moisture and gases. The outside of the stones should be

smooth and the layers of mortar incline slightly to shed water, that no dampness may ooze in at the seams. Fig. 11.

Sun-Dried
Air in the
Cellar

Sun-dried air should be present in the cellar, and for this windows must be furnished and ventilation or a change of air assured. Two feet between soil and sill is as little as ought to be allowed, and three feet is none too much. The windows should be large, sufficient in number, accessible, made to open easily, safely protected by strong screens. The present tendency to surround the lower part of the house with wide verandas may be a menace to the healthful cellar. Too often these shut out the sun from the cellar and prevent proper circulation of air. This danger may be partly overcome by trap doors in the veranda floor over the window. These doors should be opened often to admit sunshine and dry air.

Floor of
Cellar

The floor of the cellar should be smooth, of cement, asphalt, concrete or similar impervious substance which can be swept and washed. The hard pressed clay, often seen in the country cellars, may be sufficiently impervious to dampness from below, but it can not be washed and it becomes dusty. Coal ashes with cement make a fairly good floor.

Ceiling of
Cellar

The walls and ceiling should be plastered like any room. This will allow of cleaning and also prevent much dust rising into the upper rooms. With an annual or semi-annual coat of whitewash such a cellar will be dry, clean and healthful.

It is difficult to get light and air into all parts of every cellar in city blocks, but by careful division, according to purpose, the ideal may be approximated. The heating apparatus, fuel and related necessities may be put into the dark center if such there must be, while other storage space has light and air.

Even a well constructed and well arranged cellar should be ventilated daily, summer and winter. In summer, if warm moist air enters the cellar, the moisture may be condensed on the cold walls, thus making the cellar damp. There is not much danger of this if the ventilation is continuous, as is best. In winter, economy of fuel would indicate that the cellar windows be open for a time during the middle of the day.

The properly constructed cellar used for reasonable purposes and carefully cared for will be clean, light and airy, therefore dry and healthful.

**Divisions
According
to Use**

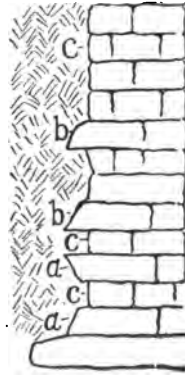


Fig. 11. Showing good and bad construction of cellar wall. a. Stones extending into soil, allowing moisture to be held. Bad construction. b. Stones should slope away if rough. c. Smooth surface next soil. Good construction.

THE BOX ABOVE

From the standpoint of sanitation perhaps the hole or cellar is of far more importance than any room in the box above. However, there are many ways in which this box, or superstructure, may be in itself or may become unhealthful.

Importance
of Sunshine

As sunshine is a prime factor in all health conditions, the sanitary house will have all it can get. We have seen how this should govern the exterior conditions. It should, as well, govern the interior arrangements.

The ideal house has sun in every room for a portion of every day, both summer and winter. This is impossible on city streets, and a house can be healthful without this extreme. But the sun-plan of every house should approach as near to this ideal as possible.

The
Sun-Plan

The sun in summer rises some distance north of east and disappears considerably north of west. (Fig. 12.) Its winter rising point is considerably south of east, and it disappears at a point far south of west.

Winter's
Sun

The house, then, should be placed and planned so that it may receive the winter's sun in as many rooms and for as long a time as possible. This requires attention not only to the rooms, but to the windows, and it is attained better when the axis of the house is at an angle with the points of the compass, not parallel with them.

The house in Fig. 12 would certainly have sun

in every room in summer. The rooms might be so arranged that with projecting bays a little sun might enter every room even in winter.

The detached house is easily made ideal as to sun-plan, but the city house is a harder problem. Few houses can here be detached, and under such condi-

Sunshine
in City
Houses

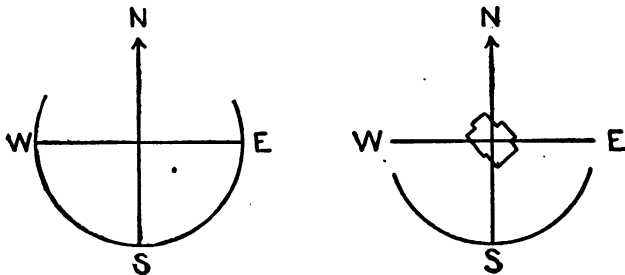


Fig. 12. Diagram Suggesting Path of Sun in Summer and Winter and Sun-plan of House.

tions the living and sleeping rooms should have windows facing south, west or east. The choice positions for city houses are those having an *unobstructed* southerly outlook (in the north temperate zone). In city blocks it is evident that houses or apartments on streets running directly north and south receive the *least* sunshine. The points of the compass should be accurately observed in selecting or planning a house.

In the eastern United States the prevailing summer breezes come from a southerly direction, so that a house with a good southern exposure is cooler in summer and warmer in winter.

Exposure

This is not the place to discuss architecture and house construction, but a few closely connected points which involve sanitary principles should be suggested.

**The
Modern
Fates**

The three Fates—Dampness, Darkness and Dust—must be routed from the superstructure as well as from the cellar, and they are very stealthy in their attacks.

**Recapitula-
tion**

Building materials, as we have seen, are capable of holding much moisture. Wood must be thoroughly seasoned, brick well burned and finished, stone of fine pores. The presence of dampness is shown by the swelling of door and window frames, or later by shrinkage in many parts. Cracks open, floors settle and become uneven. Fresh plaster contains large quantities of moisture which cannot be removed in a short time. A new house is often dangerously damp from this source.

**Living
Rooms**

Living rooms should be placed in the best positions for sunshine and dry air. Stairways and halls may occupy the less favorable positions.

**Small
Rooms**

Rooms too small cannot be healthfully supplied with air, too large rooms are liable to be dark. Neither does vertical space assure good ventilation, for it is difficult to break up the "inverted lake of bad air" which gathers above the windows.

Rooms should be so related to each other and to the doors and windows as to allow cross-ventilation and diffused light. Time and energy should not be wasted by the separation of closely related parts. The

kitchen stove, sink and pantry are active partners and have daily dealings with the dining-room and store closets.

While the ideal kitchen has no waste heat, most kitchens with northwestern exposure will be warm enough at any season and, with windows on two sides, will be light and airy.

**Ideal
Kitchen**

Sleeping rooms, above all, should have sunshine.

Bathrooms, also, should have one window at least, preferably on the sunny side.

Stairways and closets should have some means of light and ventilation. The latter should not be too large or more numerous than needed. They are expensive in construction, difficult to ventilate, and temptations to that accumulation of fabrics and "goods" which tends toward bad air, stored dust and insects. For the same expense a light, airy storeroom or attic might be built which would centralize labor and increase healthful conditions.

Closets

The finish of the house is usually determined from the factors of fashion, looks and expense. A hospital is a place where present disease is to be cured and sanitary principles should control every detail, for little assistance can be expected from the patients. A home should prevent diseased conditions. Fortunately in essentials the principles of sanitation, aesthetics and economy are not opposed.

Cleanness

From bacteriology we have learned that dust is everywhere, is composed of disagreeable, irritating

dead particles and living plants capable of spoiling our possessions and causing, in us, disease more or less violent. Sanitation seeks to prevent as many of these conditions as possible.

Parts of the house which cannot be renewed often without great expense should therefore be adapted in material, form and finish to the prevention and removal of dust.

**Texts for
Sanitary
Sermons**

Here are a few index fingers pointing along these two roads—prevention and removal.

Rough surfaces and sharp angles catch and hold dust. Light colors show dirt; they are more likely to be kept clean.

Absorbent surfaces store dust, moisture and impure air. Small cracks, crevices and angles are difficult to clean. Plane polished surfaces are usually smooth, need cleaning less often and require much less labor, when dirty. Horizontal surfaces catch the most dust; let them then where possible be non-absorbent, smooth and polished. A housewife's capital is the sum of her strength, time and money.

VENTILATION

So far our study has been directed toward a generous and constant supply of sun-dried, clean air inside the house by preventing any contamination from outside or beneath.

We cannot entirely prevent such contamination, for much of it is due to the actual processes of life and living. We must, therefore, study how to remove air when contaminated and to replace it by that which is fresh and unpolluted.

Pollution
of Air

A house means enclosed air comparatively still. The quantity available is less than in the open, while an indefinite number of chances of pollution are furnished which out-of-door life never produces.

Every article of furniture takes air space, every fire uses some, a leaky stove may pollute more; every candle, lamp, and gas jet decreases the supply and increases the impurities; the sinks and baths, the tubs and water-closets threaten its purity; while we ourselves are, with every breath, polluting that, without which we cannot live and which when very impure checks our body fires, sometimes beyond rekindling.

Besides all these gaseous impurities there are suspended in the air the miscellaneous dead and living dusts. One authority estimates that in the open country a cubic inch of air carries 2,000 dust-particles; in the cities over 3,000,000, and ten times as many in inhabited rooms. And that particular cubic inch of air may enter our lungs!

Dust

We know that for animals, oxygen is a life supporter, and that for all processes of combustion it is equally important. It is as essential to us as food materials, for they are useless without it.

**Effects of
Impure Air**

If bad air felled us like a blow, we should bestir ourselves to ward off every possible attack, but its influence is stealthy; and many a person never recognizes the thief who has robbed him of his vitality, thereby making him an easy prey to every ill.

Some of the most interesting facts concerning the deadening effects of impure air have been found out by experiments in mills and large workrooms.

In one case a mill owner at considerable cost put in an efficient ventilating system. In a short time the women struck for higher wages, saying since the ventilation of the rooms, they required more food and could not pay for it. The wages were increased. More oxygen burned more food; more energy resulted and the increased output of the mill soon reimbursed the owner for the expense of both ventilation and increased wages.

Oxygen starvation is so common and unsuspected that many of us do not know its symptoms.

**Ventilation
of the Lungs**

From the moment of birth the lungs of no vertebrate animal are entirely empty of air. At each breath only a portion of the air is exhaled, therefore only that portion can be replaced. This suggests the first step in the cleansing process—deep breathing exercises, for

in them some of the cells seldom used are emptied and refilled, that is, they are ventilated.

Billings says: "Most civilized men are unwilling to put on articles of underclothing that have just been taken off by another person, or into their mouths articles of food and drink that have been in other people's mouths; but they take without hesitation into their lungs, air that has just come from other people's lungs or from contact with their soiled clothing or bodies."

**Second-
Hand
Air**

What, then, are the impurities to which house air is subject? First the products of respiration—carbon dioxide, moisture and organic matter. More organic matter is added from other processes of excretion. Second, similar products of combustion from fires and lights. There may be also other gases according to the character and perfectness of the heating and lighting systems. Third, gases from drainage systems. Fourth, dust, with its possible germs of disease.

Impurities

All solid particles which settle from the air must be removed by mechanical cleaning processes, but the removal of gaseous impurities belongs to ventilation.

Out-of-doors, impure air is subject to the action of winds and to rain. These carry away, dilute and wash out the harmful matters. Vegetation also flourishes on what would kill us, and the sun exerts its varied influences. Inside the house all these purifying agents are practically absent, although the various movements of the family, the swinging of doors or the rocking of

**Natural
Means of
Purification**

chairs, all tend to create some wind, which is simply air in motion and all these currents help in ventilation by preventing stagnant air.

Bees ventilate their hives by working their wings up and down.

**House
Plants**

As green plants take the carbon dioxide from the air, working it over in their chlorophyl cells, house-plants are purifying agents as well as a source of pleasure. However, this goes on most vigorously only in sunlight, so that plants are not similarly healthful under artificial light. It may be that they do some work under electric lights, but not in the house to any great extent. Where plants cannot flourish in a room human beings likewise suffer.

**Principle of
Ventilation**

If a small lamp chimney be placed over a bit of lighted candle the latter burns for a little while, but soon smokes and goes out. We know that the flame produces carbon dioxide, which cannot support combustion. Insert a splinter or match under the chimney and the candle will burn longer and better, because the air enters the tiny crevice, furnishes a little fresh oxygen for the flame and the carbon dioxide is carried away through the top; or, as it begins to burn poorly, place a piece of tin or zinc vertically across the top opening. The flame is refreshed. Hold over each half of the opening a very light feather and see it bend downward over one and blow upward at the other. This shows that air is passing in at one and out at the other flue. In both cases we have a simple

ventilating shaft, because we have furnished two holes. The heated air expands, is lighter and is forced to rise by gravity drawing the heavier cold air downward.

Air does not move of its own accord; there must be a difference in temperature between the air of the room and that outside, or there must be wind.

Ventilation is simply a change of air, and two holes are necessary to effect this change. When one hole is very large the air may itself virtually make two out of it by passing in on one side and out at the other. This, however, is never as effective as where there is a division between the holes. Diffusion is more complete where the holes are at different levels.

Outlet
and Inlet
Necessary

Not so very long ago this carbon dioxide was considered the most harmful ingredient of impure air. It was known to be heavier than air, therefore the worst air was said to be at the bottom of the room. Yet if candles be burned at different heights in a closed box the upper will be extinguished first.

Behavior
of Carbon
Dioxide

It makes a difference in its behavior whether this carbon dioxide is at the same, lower, or higher temperature than the air. When it is given off from our lungs or from any flame, it is much warmer than the surrounding air. It, therefore, is lighter and rises.

Any one who has hung pictures or put up curtains needs no further proof that heat, moisture and closeness increase toward the ceiling, and the foulest air in a heated room is usually near the top.

Carbon
Dioxide
"Not Guilty"

But the question may be asked, is this carbon dioxide guilty of all the sins of bad air? In breweries, in wine vaults where it is a product of fermentation, in soda-water factories where it is manufactured pure, with the presence of two or three times as much as is ordinarily found even in the most impure rooms, no harmful effects are noticed.

It is now known that the moisture and the organic ingredients present are in themselves more deadly than the carbon dioxide. When "Tom, Dick and Harry" get together mischief follows. The slowest of foot may be seen and caught. He may not be the most to blame, but he is in bad company and available for punishment. Just so with this gas. It is always present where the other more harmful ingredients are and, as it can be caught and weighed, it is taken as the measure of impurity. At present, science has not been able so successfully to measure and test the other impurities.

Theoretically, the air of the house should be as pure as the air on the mountain top, but in any enclosed place this is impossible, as we have seen. All that can be asked for is safety.

"Pure" or
Safe Air

"Pure country air" is found to have about two and one-half to three parts carbon dioxide to every ten thousand parts air. This is taken as the standard and made the basis of comparison. The air of cities is not equal to that of the country, therefore the range of

variation will be changed. It should not, however, be more than three and one-half or four parts in excess at most, so that the presence of six or seven parts of carbon dioxide to every ten thousand parts air, is called the permissible limit.

It has also been found that as the carbon dioxide increases from six to ten parts in ten thousand, a musty odor is often perceptible; when it rises to eight and fourteen the room is said to be "close" and the air is debilitating. However, these effects may not be noticed except by comparison with pure air.

**Musty
Odor**

In many persons the sense of smell is not normal, but if this is keen and its owner comes from the fresh air of out-of-doors it is an efficient test. Thompson-Seton says: "Man has sold the birthright of his nose for the privilege of living in towns."

**The
Educated
Nose**

President Eliot has said: "The sense of smell deserves a careful training, for it is * * * the best natural protection against corrupted food, drink and air." The educated nose should be constantly exercised. It will bring many uncomfortable moments, but may lead to the prevention of hours of suffering.

The chemist has his accurate tests for these impurities, but none of them are practicable for the amateur or housewife. She should study the conditions of her own house and make good use of her nose.

A strong dose of a poisonous drug will kill while a weak or dilute dose may produce no effect.

It is found that an adult at rest needs about 3,000

Amount
of Air per
Person

cu. ft. of air per hour, that the functions of the body may continue. Children and the sick need more than this. Thus a room 18 feet by 18 feet by 9 feet would furnish the required air for one person for one hour without any ventilation. At the end of the hour the entire contents would need to be changed. This in cold weather would mean a room uncomfortable until it could be reheated. What is necessary is a constant removal of impure air and an equal supply of fresh air. Cold air entering rapidly, as by an open window, has no time to be warmed before it strikes the body. The chilling of one part may affect the whole injuriously. The same amount of air sifting slowly in through small openings would not be felt. The bamboo partitions of Japanese houses allow the wind to sift through without unpleasant effects. Experimenters have found that the air of a room cannot be changed more than three times an hour without danger of drafts. The 3,000 cu. ft. with three changes might be furnished safely in a room 10 feet by 10 feet by 10 feet, but not in a smaller room.

Size of
Rooms

This, then, indicates that a room with one occupant should not have less than one thousand cubic feet of air space. Many a sleeping room among the poor is occupied by two or more and has less than three hundred cubic feet of air space. In small rooms, too, any two openings will be so near together that the air is apt to pass through without proper diffusion.

These figures offer suggestions rather than definite

rules. They show the danger of small rooms and the special attention necessary to make them healthful. The smaller the room, the more need of ventilation. How to get these more frequent changes without drafts is a difficult problem.

Because the worst air is toward the top, it is evident that here should be the outlets. Especially should the products of combustion from lamps and gas fixtures be carried out while hot and not be allowed to cool, sink and mingle with the air which is being breathed by the occupants of the room.

**Position
of Outlets**

If an outgoing current can be established air will come in. A certain amount of change of air takes place at all times through walls, around cracks and crevices of windows and doors. Whether this be outward or inward depends upon many conditions of temperature and pressure. A lighted candle held near the crack of a door, a window, the fireplace, etc., will show in which direction the air is passing. Plastered walls allow much air to pass in and out. Papered walls are less pervious, while oil paint practically closes the pores.

The ideal house is as carefully planned for the escape of impure, and the supply of fresh air as that this air should be comfortably warm. Windows are not primarily for purposes of ventilation, but the average house still depends upon them. They should, then, be arranged to lower from the top. But this, in certain conditions will carry out a great deal of

**Methods of
Ventilation**

heat. It should be remembered that a very small opening will allow much air to pass through. The rate of change depends upon the difference in temperature and pressure between the outside and inside air. It is better to have a small opening all the time than a large opening occasionally.

**Lowering
the Top Sash**

The lowering of the window at the top leaves a space between the sashes for fresh air to enter, and as it is directed upward by the sash it mingles with the warm air. It is, therefore, felt less when it reaches the person.

**Window
Boards**

Other devices are often more effective. The lower sash may be raised and a loosely fitted board inserted, or it may be placed between the upper sash and the top, where it is less noticeable. The board may be finely perforated, or, as in car windows, have a few holes closed with a slide. It may be fitted to a slot in the casing and the window raised behind it. This is a simple and an efficient way of providing two openings. In some rooms this is objectionable for day use as the board shuts out light.

Fig. 13 shows a ventilator where the board is replaced by glass held by adjustable metal strips to be opened at different angles. The oblique glass directs the air upward and little or no draft is produced.

The upper part of the window may be arranged as a transom, adjustable at different angles. When open it would look much like Fig. 13 without the side brackets.

We know how ordinary fly screens break up the entering currents of air. The same idea may be carried out to still greater extent by having a small frame

Screens



Fig. 13. A Window Ventilator of Glass—Inside View.

covered with cheesecloth placed in the open window.

The cloth may be doubled and stitched together at two edges, making a bag which can easily be slipped

on and off the frame for frequent washings. This allows slow circulation, prevents drafts, filters out much dust, and interferes little with light.

Down
Draft
From a
Window

The layer of air next to the outside walls and the windows is naturally colder than that elsewhere, so that a person obliged to sit near them is uncomfortable. A screen of some kind should be placed between the wall and the person. A high-backed chair may answer; or in the case of the window, a strip of cheesecloth stretched tightly across breaks the draft while it diffuses the light.

Position of
Windows

So long as windows are depended upon to furnish ventilation they should be so placed that they may be efficient. Fortunately, that which is favorable for this secondary use is favorable for their primary purpose as avenues of light.

Windows should reach very nearly or quite to the top of the room that when open the layer of impure air near the ceiling may be removed. They should be placed in diagonally opposite walls to allow of cross-currents. They should not be so covered with shades and draperies that air can pass neither in nor out. Some of the Colonial houses are excellent examples of window architecture and position.

Double
Windows

Double windows not only prevent the entrance of wind and storm, but they make the house much warmer because of the layer of warm air between them. This, however, prevents the air inside from passing out and therefore lessens the ventilation. They should

either be built in permanently with the house or the removable ones should have at least one hinged or sliding pane which may be opened. If built in, the two sets may be opened alternately at the top and bottom.

A transom over a door opening into another room

Transoms

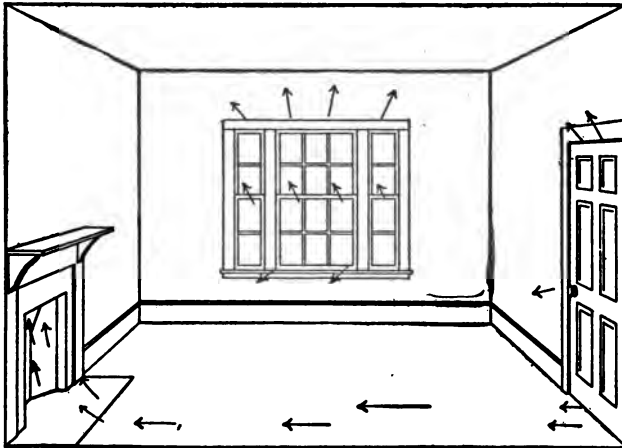


FIG. 14. AIR CURRENTS IN A ROOM
Showing How a Fireplace Acts as a Ventilator.

in which is an open window is one way of ventilating rooms with little danger from drafts.

A good fireplace, grate or other open fire not only takes air from the room to support combustion—and this must be replaced—but also creates a constant outward current of heated air up the chimney. Fresh air will be drawn in from around windows and doors, as shown in Fig. 14.

Fireplace
as a
Ventilator

An open fire is no doubt the best ventilator possible.

**Heated
Flues**

This is the simplest form of ventilation by heated flues. So long as the air inside any flue rises there will be constant ventilation of the room with which the flue connects.

A small flame will heat quite a column of air, so that, if a fire be undesirable, a lamp, or a gas flame inside the grate or fireplace will give considerable ventilation and little heat.

One flue may be heated sufficiently to create an upward current of air in an adjoining flue. The kitchen or heater fire may thus serve to ventilate a room above, although that room may have no fire in its fireplace.

In some rooms an unused stove-pipe hole near the top might serve as a ventilator if that flue were not in use. If in use for a fire lower down, there might be trouble from smoke and also less draft for the fire.

**Outlet
at the Top
of the House
Important**

As the house acts like a chimney, there should be an opening at the top to let out the bad air and ensure a constant current upward. This is best arranged as a skylight, over the hall, parts of which can be opened much or little as conditions of wind and weather allow. Into the hall the rooms open, and it can be made the ventilating shaft. Sometimes a ventilating pipe is run from the ceiling of the hall into an attic or a space with louvered openings to the outside air. If no other way can be found, let a window in one of the highest rooms be left open a little way.

If this outlet be furnished, the constant current will ventilate the entire house. Such ventilation has been described as the "breathing of a house."

The direction of the air currents in the house may be tested with smoke. A Chinese joss stick, a slow match or punk stick, familiar about the Fourth of July, even two or three strands of common white string, will give a continuous thin stream of smoke. It must be remembered the heated smoke naturally rises in a quiet room, but this test will show plainly the currents of air around windows, through cracks, or up fireplaces. Tests may be made also with a candle flame. The curve of the flame will show whether the current is in or out.

Testing
Air Current
of the House

Special attention should be paid to ventilation in the evening, when artificial lights add their impurities to those of respiration and there is less liability to movement which would keep the air in motion. They also greatly increase the temperature. When shades are drawn there is little danger of drafts from small openings, but if no possible provision can be thought of for a constant outgo and supply, then the windows should be opened occasionally, top and bottom, for a few minutes. If the room cannot be vacated while it is being rewarmed, let the occupants exercise a little to prevent any chill.

Evening
Ventilation

If the air outside be still and about the same temperature as that inside, it may be difficult to create a current sufficient to change the air of the room. Mov-

ing a door back and forth, rocking vigorously or swinging a large fan will create currents and facilitate the change.

Night Air

To furnish fresh, clean air in the daytime is important, to ensure it at night is, if possible, more necessary. At night, during sleep, the body carries on its recuperative powers to the greatest extent; the wastes of the day are replaced, the reserves laid by, and these all require large amounts of oxygen for their perfect operation.

Certainly the Creator who made animals dependent upon oxygen for their life would not shut off their supply for eight to twelve hours of darkness, so that the idea that "night air" is not suitable to breathe should not be entertained. Its composition does not change when the sun sinks behind the horizon. As it cools it loses much of its capacity for moisture, and as the earth and vegetation become colder this excess condenses upon them and there is consequent dampness. In some sections or for abnormal conditions of health, it may be necessary to furnish artificial heat to take up this dampness. Sleeping rooms near the ground are more liable to be harmfully affected by this squeezed-out moisture.

During a still night most of the dust settles and is held by the dampness so that the morning air is much *cleaner* than that of the preceding evening.

Let there be as much or more air at night, clean and pure, but be sure that no cold drafts chill the unconscious sleeper. Have open windows, if other means of

ventilation be not sufficient, but in cold weather thoroughly protect the sleeper by effective screens either in the windows or between them and the bed, and furnish heat if necessary.

Dampness can be kept out by inserting in the aperture of the window a screen of cheesecloth or coarse cotton flannel, the woolly side out.

The fallacy that because air is cold it is thereby pure; or warm, that it is impure, has killed many a person. In some diseased conditions there may be great danger in breathing all night intensely cold air; but no person is helped by *impure* air. To have the air pure and warm means more heat, and ventilation does cost! But the lessened vitality or actual disease due to lack of ventilation costs even more in the end and many persons die because they are unwilling, as they say, "to heat all-out doors."

**Cold Air
Versus
Pure Air**

Some houses or rooms are more poorly ventilated in summer than in winter. The air outside being warmer than that inside, the desire is to keep it out. Often this results in shutting the windows during too much of the day. Unless great care is taken this may result in damp, stagnant air within the house, which is far more unhealthful than a little excess of dry heat. Fortunately, artificial lights are lessened and there is more out-of-door life to counteract the bad influences. Any occupied room should have a bath of fresh air every day and the sun should not be shut out entirely from any room for many days at a time.

**Summer
Condition**

The air in many a country boarding-house parlor on a summer evening compares favorably with that in a city tenement, while many city housewives need to be careful how they sacrifice purity for damp coolness.

**Mechanical
Systems**

All methods, except the heated flue, that we have so far spoken of refer to natural ventilation, because these are most common in private houses. In public buildings and in some private houses, mechanical means are employed to drive in fresh or draw out impure air. The former is known as the *plenum* system. Fresh air is drawn into a special chamber and driven from that through air shafts by the action of a blower. Of course outlets must be arranged, and the air should be warmed before entering the rooms. In another, known as the *vacuum* system, the impure air is withdrawn from the rooms through pipes opening into a central shaft, thence out-of-doors.

The *plenum* system seems to be most favored, both from ease in regulation and expense of operation. An adaptation of the vacuum system is by the use of the electric fan. This sometimes simply keeps the air in motion, thereby providing currents like any hand fan. Sometimes they are situated near outlet-flues or open spaces and so tend to drive out the air. They can be used wherever an electric current can be obtained.

**Ventilation
and Heating**

The most efficient means of ventilation is in connection with the heating system, as we shall learn later.

TEST QUESTIONS

The following questions constitute the "written recitation" which the regular members of the A. S. H. E. answer in writing and send in for the correction and comment of the instructor. They are intended to emphasize and fix in the memory the most important points in the lesson.

HOUSEHOLD HYGIENE

PART I

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. *Use your own words*, so that your instructor may know that you understand the subject. Read the lesson paper a number of times before attempting to answer the questions.

1. For what reasons is Household Hygiene of especial importance to women?
2. What are the conditions outside and inside that tend to make and keep a house dark and damp?
3. How can dust make unhealthful conditions in the house?
4. What is meant by "ground air" and why is it unhealthful?
5. What would you consider an ideal location for a house?
6. What dangers are connected with "made land" and how can it be rendered healthful and safe?
7. How would you have a damp site prepared and drained?
8. Why is the cellar such an important part of the house?

HOUSEHOLD HYGIENE

9. Think of the worst cellar you have ever known and tell how you would change each bad condition.
10. What is the "sun-plan" of a house? Why is a southern exposure desirable?
11. What are the sources of impurity in the air of the house? Why is ventilation necessary?
12. What do you understand ventilation by heated flues to mean? Give an illustration.
13. How and why would you ventilate your cellar in winter? In summer?
14. (a) Give two or three ways you have tried for safely ventilating a room. (b) How ventilate the house as a whole?
15. What can you say of night air? Is cold air necessarily pure?
16. By the use of a candle flame and with smoke, note the strength and direction of air currents through the cracks around doors and windows; near the floor; a foot from the ceiling; at the top and bottom of an open door between rooms; near an unused fireplace; in the vicinity of a radiator or register. Write a short account of these experiments.
17. Give a few illustrations of healthful finish and furnishings and tell why you so consider them.

HOUSEHOLD HYGIENE

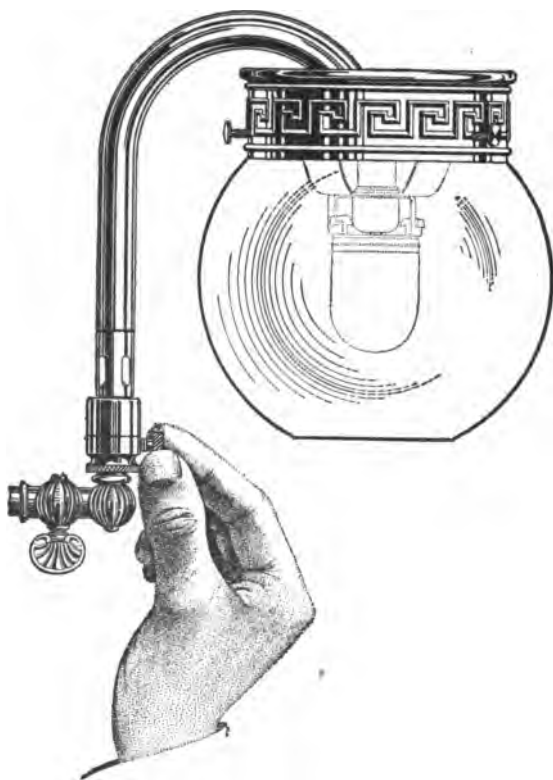
18. What are the sanitary objections to the following: (a) No fresh air in a sleeping room, (b) closed windows and blinds in summer, (c) brick for cellar walls next the ground, (d) windows which will not open at the top, (e) a house with floor beams lying on the ground?
19. Describe the chief unsanitary conditions of some house of which you know.
20. Has any suggestion, for better sanitary conditions in any house, come to you as a result of your study of this lesson? If so, what?
21. What questions have occurred to you in the study of this lesson?
22. Do you understand all parts of this lesson? If not, what is not clear?

NOTE.—After completing the test sign your full name.

Household Hygiene

Part II

3300



INVERTED INCANDESCENT MANTLE GAS LIGHT

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HOUSEHOLD HYGIENE

PART II

HEATING

Only a little more than a hundred years ago heat was thought to be an elastic fluid, called caloric, which penetrated the warmed object. When Sir Humphrey Davy showed that two pieces of ice rubbed together would melt, he showed that heat, like light, is a form of energy. This energy is now understood to be, or to result from, the irregular movements of minute particles, the molecules of which all matter is composed. The faster the molecules vibrate the higher is the temperature. When these vibrations become sufficiently rapid to affect the optic nerve, we have light.

**Definition
of Heat**

We know heat may be produced by mechanical means—the hands are warmed by rubbing them together, a nail is warmed when struck with a hammer; or by chemical action as in combustion. The sun and the combustion of food in the body are the natural sources of heat.

**Sources
of Heat**

The heat of the sun is transferred to our earth by *radiation* in straight lines through first, the “ether,” which is supposed to fill all space; next, through the atmosphere to the surface of the earth. Comparative-

**Transference
of Heat**

ly little of this radiated heat is absorbed by the air or other bodies transparent to heat. Let a person stand before a window or in the open air, in the direct rays of the sun, and he will be warmed even on the coldest day. The glass and air are transparent to radiant heat as they are to light.

Conduction Heat is transmitted in other ways—by *conduction*, as a curling iron becomes hot when one end is held in a flame; by *convection*, as a kettle of water is heated by the movement of the heated portion of the water from one place to another.

Solids are heated by *conduction*, by *radiation*, or by the two combined. Liquids and gases are heated by *convection*.

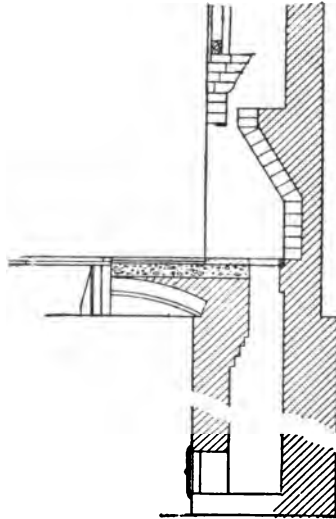
Heat and Light As radiant heat and light are so closely related, it is to be expected that they follow the same laws. Thus, certain bodies are transparent to radiant heat as has been seen. Polished surfaces reflect radiant heat and light; dark colored, rough surfaces absorb heat and light almost completely. Surfaces which absorb heat readily, radiate it easily; for example, surfaces which are black and rough send off radiant heat more freely than polished surfaces. Thus a kettle of hot water will cool faster in a rough black kettle than in a polished one.

Artificial Heat While the sun is the natural source of heat, and the more sunshine a house receives the more healthful it is, it is equally true that in such a house the least money will be spent for fuel. It has been found by

experiments that fifty per cent more heat is required to warm rooms on the north than on the south side of the same house.

The claims of health and economy unite as well in the choice of any system of artificial heat.

The oldest form of heat giver, the fire-place, is pre-eminently a ventilator rather than a heater, for all but about ten per cent of the heat rays go up the chimney or are nearly wasted in the enclosing sides. The heat obtained is chiefly radiant heat, so that the side of a person in front of the fire is made uncomfortably warm while the other side remains cold. So much air from the room is used in the support of combustion that the colder air drawn in from outside makes constant drafts from windows and doors; or, if the air is drawn from other parts of the house it is not fresh air. Often the chimney is too large or



Fireplaces

Fig. 15. Sectional View of a Well Constructed Fire-Place.

too short and allows back drafts, or not large enough to carry off the products of combustion so quickly and thoroughly that a good draft is possible. In both cases smoke is thrown back into the room. Much, however, depends upon the material, proportions and construction of the fireplace.

There should be a separate flue for every fire in any chimney. The throat of the fireplace flue should be contracted by the back of the fireplace, slanting toward the front, Fig. 15, that the large amount of air above may forcibly "pull" the smoke upward; the sides should be curved or join the back in an oblique angle, that all the rays may be sent into the room. The lining should be a poor rather than a good conductor of heat. The linings are always darkened and roughened by the smoke and soot and as all dark, rough surfaces absorb rather than reflect heat, the amount of radiation from the flue is increased thereby.

**Heating
Fireplaces**

The fire on the hearth cannot be considered an efficient source of heat for extreme cold weather. If all the heat could be thrown into the room the fireplace for a small room might be sufficient. There are so-called "ventilating" fireplaces which might better be called *heating* fireplaces, because they are more effective than the ordinary form. In these a flue in the wall brings a constant supply of fresh air to circulate about the back and sides of the fireplace. When heated, this air rises and passes into the room through registers. This results in economy of heat and better

diffusion of the heated air. The principle is a good one, but the difficulties of construction bar them from general use.

With all open fires there must be dust from the fuel and ashes, but with proper care this may be reduced to a very small amount. It should not outweigh the great advantages of cheer and the purer air which "a fire on the hearth" ensures.

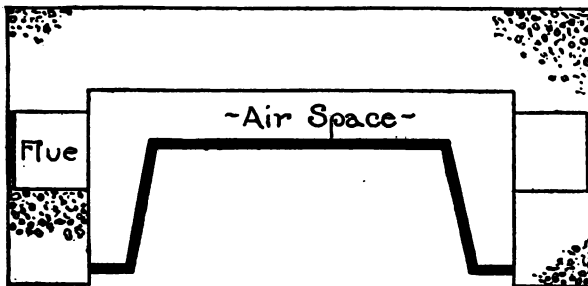


FIG. 16. A VENTILATING FIRE-PLACE.

A large part of the heated surface of a fireplace or grate is in the wall. If the open fire be held in a well-proportioned stove or grate standing out in the room like the old-fashioned "Franklin," Fig. 17, of which there are now excellent reproductions, and this connects with the flue by a broad stovepipe, a considerable amount of heat is obtained and excellent ventilation is assured. These are now made to burn either coal or wood.

Open
Stoves

**Closed
Stoves**

A closed stove, which may be considered a box, stands away from the wall surrounded on all sides by the air of the room. The fire within heats the enclosing sides chiefly by *conduction*.

One of the effects of heat is expansion and consequent lightness. Air in contact with the heated surface of a stove becomes lighter. Gravity causes the colder, heavier air to sink while the warm air rises. Air flows toward the stove from all parts of the room until the whole air is warmed. This method of diffusing heat by the actual change of position of portions of air is called, as has been said, *convection*.

During the same time, rays of heat pass outward from all parts of the stove so that the floor and furnishings are heated chiefly by radiation while bathed in warm air. No room feels warm until all parts and the furnishings are of nearly uniform temperature.

**Stoves and
Ventilation**

Some of the air from the room is needed to carry on combustion. Its place will be supplied by air from cracks and crevices around windows, doors, etc. In a very tight room this interchange might be so slight that the fire would grow dull or even go out. The process of combustion in our bodies—our body-fires—would certainly be dulled in such a room.

The fire in a stove needs so little air for combustion that there is likely to be insufficient ventilation. This is one disadvantage. Theoretically the only change of air possible is in replacing that used by the

fire. The same air therefore is heated over and over to a higher and higher temperature. In occupied rooms it soon becomes laden with the impurities from respiration, from lights and from other sources. Many of these are invisible, solid, organic particles which become actually burned and give the characteristic odor of "burnt air."

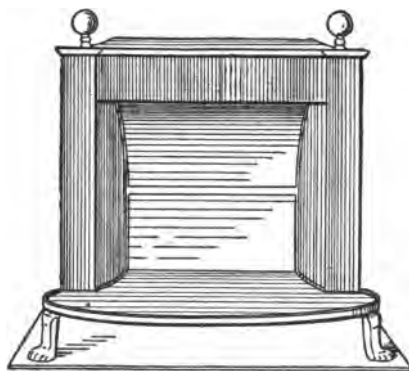


FIG. 17. A MODERN, "FRANKLIN" STOVE.

Pure air always contains a variable amount of moisture. This is absolutely necessary for processes of healthful life. Hot air has a greater capacity for holding moisture than cold air. In the over-heated room, the air draws this further supply from every available source, first from our bodies, next from the finish and furnishings. The moist lining membranes become dry, parched, irritated; the furniture shrinks, cracks

Moisture

and grows brittle. Everything tends to go to pieces like the "one hoss shay."

**Amount of
Air Used
by Stoves**

The amount of air drawn through a closed stove is only about one-tenth of the capacity of the room. It would then require ten hours to completely change the air of any room by the stove alone. Fortunately, the interchange of air through cracks, open doors, etc., helps, else all stove heated rooms would be suicidal. Thorough ventilation of rooms heated by stoves is thus seen to be imperative.

Where thorough ventilation is looked out for, the best stoves are healthful and economical; but ventilation and therefore health will require more fuel than is used under the unventilated, unhealthful conditions.

**Excessive
Moisture**

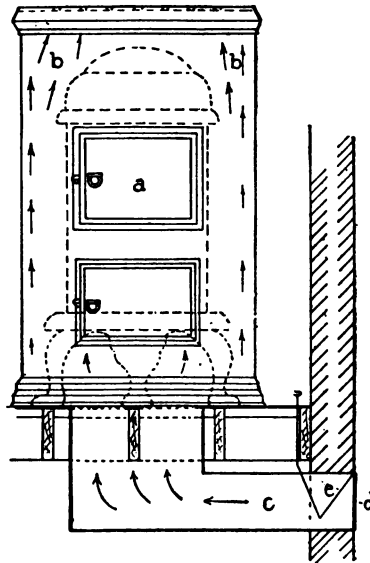
Stoves should never be heated red hot. There should be a slow, constant supply of fresh air. If this is not possible, then there should be frequent changes of air and a dish of water kept on the stove to supply moisture. Excessive moisture, as sometimes shown by steam covered windows, should, however, be avoided. This condition is extremely debilitating and productive of chills, because the natural evaporation from the body is interfered with and the skin is made sensitive and tender, or less able to resist contact with cold air.

There are well built houses where stoves are carefully run, where doors are left open throughout the house to ensure low uniform temperature and to prevent sudden changes which are dangerous; where

fresh air is recognized as a necessity both from the standpoint of health and economy—such houses are as healthful as any; but oh, the labor required to run the stoves!

A stove may be surrounded by a sheet iron jacket, making an air space, to which fresh air is admitted from out of doors. The inlet may be governed by a damper and the top be perforated like a register. Fig. 18 shows the principle of such a ventilating stove. Its heating capacity is increased because of the more perfect circulation of the warm air.

The surplus heat from the kitchen range may be allowed to pass through a register in the ceiling around which is a perforated drum. In this way an otherwise unheated room may be warmed without expense and at the same time the



**Jacketed
Stoves**

FIG. 18 A JACKETED STOVE.
a. Stove. b. Sheet Iron Jacket. c. Cold Air Flue. d. Screen. e. Damper.

kitchen made more comfortable. An open window in this upper room would tend to ventilate the kitchen without troublesome drafts.

**Oil and Gas
Heaters**

Oil and gas stoves, gas logs, or heaters are convenient where there is no provision for other fire, or for quick heat. They are easily controlled with practically no waste of fuel. However, unless the products of combustion are removed by a special flue or by extra ventilation, they are very unhealthful, if not positively dangerous.

The best oil, burned in well constructed and clean stoves, should produce nothing but carbon dioxide and water vapor which ordinary ventilation would remove. With gas, unless the burner is in perfect condition, the products are these combined with others, many of which may be irritating and poisonous.

With assured ventilation and tight fixtures gas can safely be used for heating. Gas radiators may be jacketed like a stove and connected with a fresh air supply.

FURNACE HEATING

A jacketed stove is in principle a warm-air furnace, only the latter is usually put into the cellar and the warmed air distributed by pipes. Fig. 19. The stove part has its fire-box, smoke flue, and ash pit, its drafts and checks.

Construction

The front of the stove forms the outside of a portion of the enclosing box. The box may be of brick, forming a set furnace or of iron, galvanized or not, and is usually round, as seen in the more common portable furnace.

The mechanism of the stove part so far as the fire is concerned is unaffected by the air chamber. Its smoke flue simply passes through it into the house chimney. The part of the stove over the fire-pot may be expanded into a "drum," deeply corrugated, built in cone-like tubes or any device feasible for increasing the heated surfaces, that the cold air may be fully warmed during its journey over them.

Opening into the air chamber, either underneath, at or near the bottom, is a conduit—the cold air box—connecting with the outside air. A cleanout opening into this chamber should be present.

The Cold
Air Box

Many furnaces have extending into the air space somewhere near the bottom of the chamber a pan or reservoir for water, which by evaporation will supply moisture. The first furnaces used were usually too small for the work they were expected to do, that is,

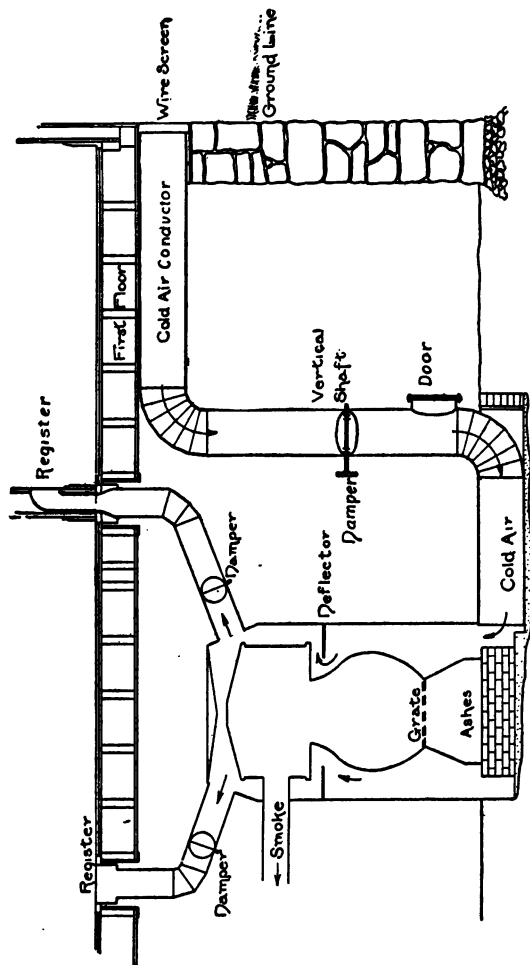


FIG. 19. A HOT-AIR FURNACE.

the small amount of air furnished was over-heated. This required the addition of moisture, the same as with the stoves previously described. The modern furnace, with large, cold air box, when properly run does not furnish this excessively dry air so that the water-pan is often absent or unused.

From the top of the air chamber opens the warm air ducts passing vertically or obliquely upward, opening at last through registers into the rooms above. Each should have a damper. Theoretically this system should furnish a constant supply of fresh, warm air to every room. Practically it does not always do this, because the air entering the cold air box may be impure; the box may not be of proper size or it may be dirty; the furnace may leak gases or dust into this chamber, or the fire may not be run properly. Health requires that there should be a large amount of air moderately warm and thoroughly diffused without drafts. The entire house should be of nearly uniform temperature to prevent the sudden changes which are inevitable when halls and some rooms are unheated. The addition of fuel required for this is only a small amount.

The cold air box measures the amount of air admitted. This, then, must not be too small or too large. It must be proportioned to the size and number of rooms. Some engineers require that the sectional area of this box be equal to the combined areas of all the registers in the series, minus one-sixth. The one-

**Warm Air
Flues**

**Size of
Cold Air
Box**

sixth is subtracted because cold air in becoming heated expands that amount. Others consider that it should equal the area of the registers. If too large, the fire-pot may not hold sufficient fuel to heat the air; if too small, it will be necessary to raise the air to too high a temperature.

**Cold Air
Intake**

The box should be of metal, smooth inside, with few and tight joints to prevent leakage of cellar air. Any opening provided for cleaning must be closed tightly. It should have a damper to regulate the supply according to the inclemency of the weather. The custom prevalent in some cold sections of the country, of taking the air supply of the furnace from registers in the rooms of the house near the outside doors, or from the cellar or from under a veranda, is contrary to sanitary requirements. It will, no doubt, save fuel, but not health. The outside opening should be removed from any source of impure air—drain, cesspool, privy, garbage barrel, etc.; raised at least two feet from the ground and protected by wire netting from the entrance of leaves, vermin and coarse dirt. In a city house it preferably should not open on the street side. Unless it has a cheesecloth or other filter, it sucks in a large quantity of dust which in the pipes becomes powder. This finds ready access to the rooms and makes frequent cleaning necessary. An unclean air box is often the unsuspected source of filthy “burned flesh” odors, for the organic dust it gathers is carried against the hot iron. Roast beef gives odors.

**Dust
from the
Furnace**

Why not roast animal dust and also roast microbes?

Much dust which rises when the furnace is shaken comes from these dust-laden pipes. If the stove is tight in all its parts, no ashes or smoke can ever find their way into the warm air ducts except through a leaky cold-air box or by way of the cellar. But these ducts seldom fit into the register boxes so tightly that dust and smoke will not pass through the crevices.

There is always possible danger from escaping coal gas even when the joints of the furnace are at first absolutely tight. The alternate expansion and contraction may loosen them and permit the gases to escape into the air chamber; or by careless management they escape into the cellar and thence to the rooms above. Of these the carbon monoxide is the most dangerous. The sulphurous gases are disagreeable and irritating, but not equally harmful. The household silver will often prove the escape of such gases when it is not detected by persons. The greater part of the dark tarnish on silver is caused by sulphur somewhere.

Coal
Gas

When the cold air box and fire pot are proportioned to each other and both to the house, the pipes and registers have still their effect upon the result. The warm air in the pipe is lighter than an equal amount of cold air outside. The difference between them is variable, however, and may be overcome by slight influences. Wind blowing from one direction may prevent the heated air from rising on the exposed side of

Irregular-
ities of
Heating

the house, while the opposite side is uncomfortably warm. It is said to be as difficult to drive the warm air ten feet against the wind as forty or fifty feet with the wind. It is, therefore, wise to open the cold air box toward the windy side of the house, or to have one on each side to use as occasion requires. The furnace itself should be placed nearly in the center of the house or nearer the coldest side.

If a register fails to give out heat for any reason, all the other warm air ducts may be closed temporarily; this forces the hot air through one pipe and establishes a current which will usually continue after the other ducts are opened again.

As the long vertical ducts offer less resistance to the rising air, the upper rooms are usually heated without difficulty, while those nearer the furnace may be cold.

**Limit of
Heating
Distance**

The warm air furnace is seldom effective for heating a horizontal distance over forty to fifty-five feet from the fire drum.

Fuel is saved when the warm air ducts are covered with asbestos or other non-conducting material. Cold drafts are prevented from withdrawing heat from the ducts and waste by radiation from their surface is lessened.

**Spring
and Fall
Conditions**

All rooms of a large house can seldom be heated with equal ease by one furnace. It is often better to have two small ones than one very large. In the mild weather of fall and spring, one small furnace can be

run much easier than to keep little enough fire in a large one. Some put into the fire box a removable partition of fire brick reaching far enough up to allow a good body of coal. This may divide the space in the middle or into unequal parts. Then a fire may be built only in one part, say one-third for the warmest days. "No furnace fire" in the early fall and late spring, and the damp, chilly rooms which result are responsible for many of the rheumatic and pulmonary troubles extant, while the over-heated rooms of the same periods are perhaps equally unhealthful.

The fresh air from out-of-doors will pass through the registers about 200 to 300 feet per minute, and at this rate a register 12x15 inches area at the opening will furnish from 10,000 to 15,000 cubic feet an hour.

The registers are often too small for the room. Two square feet area for ten thousand cubic feet of room space is a good proportion. If placed in the floor, they collect much dust and tempt persons to stand over them. They would better be in the wall, not opposite a fireplace or near a door or other exit where the entering warm air may be carried directly out without time for diffusion throughout the entire room.

One necessary annual inspection is too often neglected. The furnace flues and smoke pipe should be cleaned as soon as the fire is given up. This applies also to the warm air ducts and cold air box. Not only is it objectionable to have the fine dust collected in the air ducts scattered throughout the house, but it col-

**The
Registers**

**Annual
Inspection**

lects dampness and taints the air. It is also wasteful to allow soot to remain in the smoke pipe. Soot collects much dampness, while it also acts injuriously on the metal. The pipe often becomes as thin as paper without showing any signs of wear, and fires often result because of this neglect.

Summary

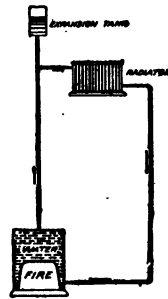
A furnace good in itself, adapted to the individual house, properly installed and intelligently run, is an economical and healthful system. Like a colt, it often seems to be wilfully opposed to doing what is wanted, but when all the individual tendencies are understood and controlled, it is a very satisfactory servant. It is an ideal ventilator when supplemented by sufficient outlets—a very little open fire completes the system and ensures ventilation. This may not be necessary during the day in large rooms with open doors and few occupants to pollute the air, but in the evening, with the added pollution of lights and possibly less movement, it is often required. Our social rooms are often veritable pest-places because of their polluted air, excessive heat and moisture.

HOT WATER HEATING

We have seen how a room becomes heated through convection by currents of heated air. Any glass vessel, like a chemist's beaker or flask, partially filled with water in which is placed a little sawdust, will show similar phenomena when heated. A wire mat over a gas or lamp flame makes a convenient place to heat this water. The sawdust will be seen to leave the bottom as it becomes warm, pass up one side and down the other until the water is uniformly heated. Water always heats in this way, whether in flask, teakettle or engine boiler.

Fill the teakettle a little too full and it will run over, because the water, like all matter, expands when heated. If the teakettle had no other opening than the spout—the spout is the easiest path of escape—and it were extended upward into a pipe sufficiently long to bend over and join the kettle again, the water would rise in it and flow round through the kettle. We could warm our hands by this pipe and it would heat the surrounding air. Suppose the kettle to be greatly enlarged, placed in the cellar, the pipe running up through the rooms and returning again to the kettle, we should then have a means of carrying heat through the house.

**Principle
of Hot
Water
Heating**



**Fig. 20. Unit of a
Hot Water Heat-
ing System.**

Circulation

This is in principle all that a hot water system is. Fig. 20 shows one unit of such a system. This may be repeated as many times as is necessary for the size of the house. Fig. 21. The boiler and all the pipes are filled with water. As soon as the fire heats the layer of water next the boiler, circulation is started and the process continues without interruption so long as there is fire to heat and water to be heated. The

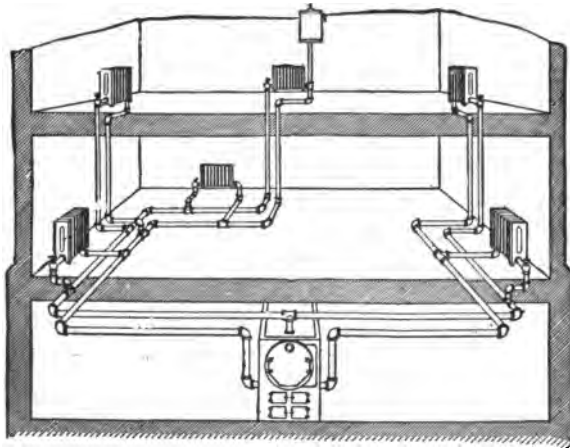


FIG. 21. TWO PIPE HOT WATER SYSTEMS.

water gives up its heat to the pipes, they pass it on to the surrounding air and it, in turn, to us and our furnishings. It therefore becomes cold, heavier, and sinks. In this way it returns to the boiler to receive anew the heat energy which will start it again on its journey.

At the top of the system is placed an open "expansion tank," Fig. 22, which furnishes some pressure, an escape for the air dissolved in the water, and allows room for the expansion of the water. This illustrates a "low pressure" system in which the water never goes above 212 deg. F.

**Expansion
Tank**

In a "high pressure" system, the expansion tank is closed, the pipes are smaller, stronger, and filled under pressure. The water can be heated to a much higher temperature, often to 300 deg. F. It circulates more rapidly. This higher heat may, under certain conditions, be less healthful and there is greater danger from bursting pipes, so that the low pressure system is the more common for the private house.

**High
Pressure
System**

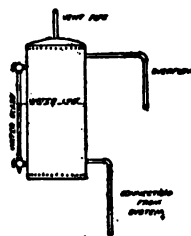


Fig. 22. The Expansion Tank.

The radiators should usually be placed in the coldest part of the room.

Hot water may be made to go where it is wanted, being much less affected than air by winds, storms, and position of the radiator. It is thus adapted to many rooms where warm air could not be used. With the low pressure system there is no danger of overheating the air of the room.

**Advantages
of Hot
Water
Heating**

Heat is available as soon as circulation is established and as this starts with very little fire the system is especially favorable for mild weather. There should

be only enough fire to keep the rooms comfortably warm.

A thermometer should be in every room, whatever system of heat is used. A person's feelings should not alone govern the heat supply.

As water will carry four times as much heat as an equal weight of air, there is economy of fuel, because there is less loss from the smaller pipes.

The pipes cannot carry dust and odors and they require no difficult and dirty processes of cleaning. It is generally considered easy of regulation. The cost of the plant is high, but its operating expense low. Its great disadvantage is—*no ventilation*.

**Combination
Systems**

A combination system of warm air and hot water has the advantages of ventilation and the easily controlled water.

The water is held in coils, tubes or hollow sections within the firebox of the furnace, so that the fire heats at the same time both water and air. In practice it is found that a little more coal is required than without the attachment. However, more work is done and the house is better heated.

Radiators

Fig. 23, 24, are types of hot water radiators with a portion cut away to show the interior construction. The arrows show the path of the circulating water.

In Fig. 23 the hot water enters at the top and leaves at the bottom.

In Fig. 24 the hot and lighter water enters by a continuous pipe along the bottom on one side, passing

directly to the top; as it cools it sinks and passes out at the other side.

There should be a small valve near the top of the radiator to let out any air which may accumulate and prevent proper circulation. The best air valves are automatic.

Air Valves

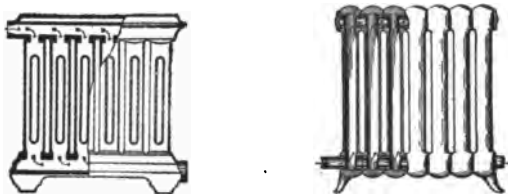


FIG 23. HOT WATER RADIATORS SHOWING DIRECTION OF FLOW.

The best results in zero weather are obtained when the water leaves the boiler at about 180 deg. F. and returns at about 160 deg. F.

STEAM HEATING

A pound of water vapor in condensing gives off heat enough to raise $22\frac{1}{2}$ pounds of air from 32 deg. to 212 deg. F. Therefore, if steam can be enclosed, it will be an excellent medium for conveying heat. Water in changing into steam suddenly increases in volume about 1728 times, so that a cubic inch of water makes a cubic foot of steam. The partially filled teakettle at the boiling point relieves the pressure by sending steam through its spout, and this becomes visible to us when it condenses in the colder air.

**Steam as
a Heat
Carrier**

The
Water
Must
Boil

Let the expansion tank, pipes and radiator in Fig. 20 be empty and the boiler only partially filled; then we have the unit of a steam heating system. When the water is raised to the boiling point steam will be given off, pass upward through the pipes, circulate through the radiators, condense into water, which being heavier, returns to the bottom of the boiler. As under ordinary conditions the water must be raised to 212 deg. F. at least before the steam is available, no benefit is received from the fuel before this point is reached. The temperature must then be kept there in order to ensure the supply of steam. It cannot safely go far above, as a slight increase of pressure and temperature opens the safety valve. As almost all regulation of the heat must be made by shutting off at the radiator and but little at the fire, there cannot be as great economy of fuel and as perfect regulation as with a hot water system.

The fire, too, must be kept up all night or the steam will not be formed, walls and floors cool off and must be heated over again before any room is comfortable. Extremes are the rule, the golden mean is difficult to attain with a steam system.

Disadvan-
tages

There is also more mechanism, requiring greater skill in management. There is slightly more danger when the system is mismanaged. The first cost of a steam plant is less than that of water, but the operating expense is greater. For large buildings in very cold sections, steam is probably the most economical sys-

tem; but it is with difficulty run so as to be equally healthful to either water or warm air.

The constant high heat to which the radiators are subjected has an effect upon them, either in material or finish, which is the cause of various distinctive, disagreeable odors noticeable in nearly all steam-heated buildings.

Odors

There is great liability to excessive dryness of air, although this can be obviated by supplying moisture. Some radiators allow a slight escape of steam for this purpose. Direct steam heating makes no provision for ventilation, while at the same time usually overheats. Therefore there should always be in addition some means for the exit of impure air. Fireplaces in steam heated rooms are almost essential. Other suggestions for these exits have been spoken of under Ventilation.

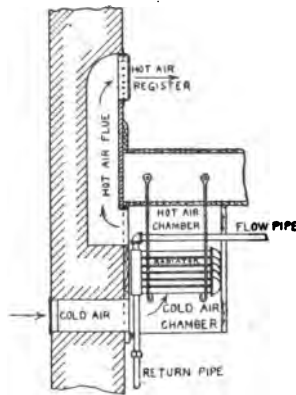


Fig. 25. Indirect Steam or Hot Water Heating.

Where the source of heat is in the room heated, as a stove, and there is no admission of fresh air from outside, the system is called *direct-heating*.

Indirect Heating

Where the source is outside the room heated, like the drum of the furnace, and fresh air is admitted, it is an *indirect* system.

The two may be combined. It is then called *direct-indirect*.

Heating
with
Ventilation

The best method will combine heating and ventilation. Besides the ways already described, hot water or steam may be used in an indirect system, Fig. 25, or as a direct-indirect, Fig. 26. The latter is on the same principle as the jacketed stove or the ventilated gas radiator drum. Air, admitted from the outside under or at the back, impinging on the radiator, is warmed and rises into the room from above, through the open space or a latticed top.

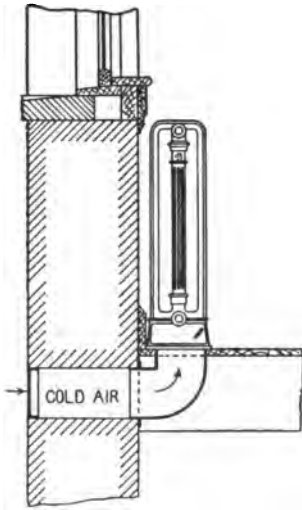


Fig. 26. Direct-Indirect Radiator.

The other method is to place the heating coils or heaters underneath the floors in specially prepared spaces, into which the fresh air enters, and from which registers or ducts lead into the rooms. Fig. 25. But here, as everywhere, there must be special outlets furnished in the rooms.

The indirect heating systems are better adapted to steam, as the hot water pipes are liable to be frozen in very cold weather unless particular care is taken.

No heating system can be healthful which disregards ventilation. No person responsible for it should be satisfied with the dangerous doctrine that ventilation will take care of itself. Fresh air does cost! probably as much as the heat alone, but strong, vigorous bodies are the valuable results of the added expenditure of money, thought and care. The best is often the cheapest even in money value. Many persons willingly put thousands into carvings and rugs, but object to spending hundreds in securing efficient heating and ventilation.

**Ventilation
Always
Necessary**

No mechanical system should ever be installed by unskilled workmen. The best furnace or boiler may be made utterly inefficient by too small registers or radiators, wrongly placed or imperfectly connected.

Workmanship

As electricity for house heating costs from 12 to 15 times as much as either steam, hot water or warm air, it is at present practically ruled out on the ground of economy. It, too, is entirely a heating system, but may, like the others, be combined for ventilation.

**Electric
Heating**

The aims in any method of house heating should be:

1. A generous supply of heated air at medium temperature and natural moisture.
2. This supply uniformly distributed throughout the house that sudden changes may be avoided.
3. The smallest amount of dust and products of combustion *inside* the house.
4. The supply easily regulated according to outside conditions of temperature and special demands in the house as age, occupation or condition of persons.

**Ideals
in House
Heating**

LIGHTING

As the sun is the natural source of heat, so it is the natural source of light. Light not only makes objects visible, but is necessary to life and health, resisting disease, retarding or preventing the growth of some germs while it kills others. It also favors certain chemical changes in the body which are conducive to health. It promotes cheerfulness and thus resists melancholic tendencies. The opposite effect on the nerves of persons in the dark rooms of eye infirmaries often retards recovery to a considerable extent.

Eye Strain

The strain on the nervous system brought on by using the eyes in too little light may derange the entire functions of the body; circulation, digestion and excretion cannot go on normally, mental force is weakened, even the moral instincts are perverted.

Color and Texture in Lighting

The illumination of a room depends very largely upon the color and texture of its walls, floor and furnishings. We see objects by reflected light and the power of reflection varies with color, surface and texture. A white wall reflects much more light than a dark one, a polished table-top more than a dull surface. In general, light colors and smooth polished surfaces reflect light; while dark, dull, rough surfaces absorb it. The finish and furnishings of rooms, then, are important factors in the problems of house lighting.

Windows

Windows are places where light may be admitted, not primarily places through which persons may see.

the outside world. They should therefore be sufficient in number and size and well placed for the respective rooms.

Too many houses are unhealthfully darkened by overhanging trees, eaves, porches, piazza roofs or window caps, to say nothing of shades and draperies kept drawn, or blinds closed as if some crime must be hidden from outside prying eyes.

Except from direct sunshine, most of the light in the house comes from the sky, which is most luminous overhead. The amount of light a window will transmit depends on the amount of sky which it commands, as well as its size. Trees and buildings which do not shut out sunshine may intercept some of the light coming from the sky.

Light from
the Sky

As the most and best light comes from the top, the modern styles of house furnishings tend to deprive every room of this most important element of health. Unless the window runs to the ceiling, the upper part of the room is in shadow. If a shadow at the top be *esthetic*, it should not be allowed to overrule health requirements. Our present style of window dressing tends to carry this shadow fully half way to the floor. There is a suggestion in the remark once overheard, "If my wife insisted on drawing all shades to the middle of the sash, I should consider it a sufficient cause for divorce."

Window
Shades
Shut Out
Light

Rooms with too few, too small or wrongly placed windows, or rooms prevented in any way from receiv-

ing enough light, may be greatly improved by a better diffusion of the light available.

**Diffusion
of Light**

It has been found that glass with an uneven surface cannot be readily seen through, but that it also, like a prism, breaks up and scatters the rays of light. This glass is known by different names—"luxfer," "solar," "corrugated," "prismatic glass," etc. It has one surface cut into angles of varying sizes or direction to suit different requirements, Fig. 27. If it be desired to light any one part of the room, the glass may be cut at a particular angle and placed in the desired way.

If undesirable to shut out all view, the upper part of the window can be of the uneven glass or a canopy of it over the upper sash can be used. This is often done in stores.

**Faded
Furnishings
or
Faded Lives**

"Let there be light!" was the first fiat of creation, and it is still necessary to cry aloud—let *in* the light. Away with every dark recess, with the damp-gathering dark closet and cupboard! Wherever dust can gather let light come. Be not so afraid of faded furnishings as of faded lives. How to light the darkness of our houses, as well as of our minds, is no easy problem.

ARTIFICIAL LIGHTING

Civilized man has long since been unwilling to stop work or pleasure and "go to bed as soon as it is dark under the table." He chooses to live under unnatural

conditions and must study carefully to adapt those conditions to a body made for very different requirements.

The sun is an intensely bright light, but it is far

**Natural
Conditions**

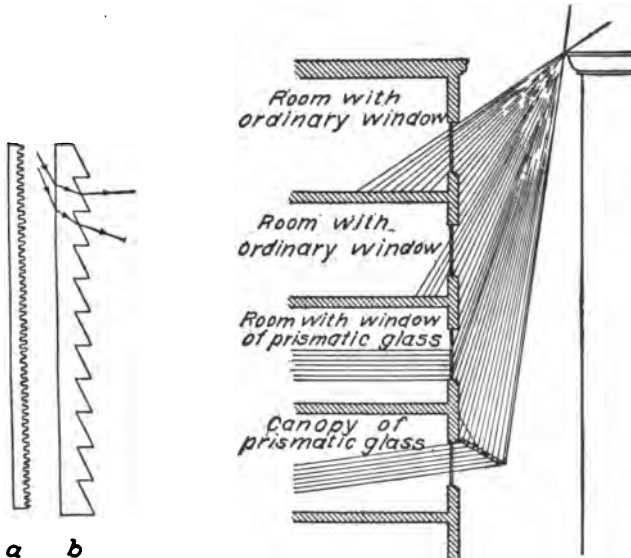


FIG. 27. PRISM GLASS.

a. Corrugated Glass. b. Prism Showing How the Ray of Light is Bent.

away, and its light is thoroughly diffused by the atmosphere. It is not intended that we should gaze at it, but by its diffused light go about the world as efficient workers. The normal eye is beautifully adjusted to this large amount of diffused light, and only when

its mechanism has been interfered with does pain or discomfort follow. Artificial light should be as fully adapted to the eye as diffused daylight. The light itself should not be seen except when it acts like a signal or warning. The blind man carries a lantern, not that he may see the passers by, but that they may see him and turn out.

**General
Illumination**

For general illumination, then, a bright light thoroughly diffused by globe or shade might seem ideal. But in a large room, one light cannot be diffused as well as more lights in different places. A twenty candle power lamp does not light a room as well as twenty candles placed in different parts. In general it may be said that a room is best lighted by either few intense lights or a number of medium intensity thoroughly diffused, placed in different parts of the room, above the heads of the occupants. All flames should be shielded from the eye and their light diffused through slightly opalescent globes or other similar means. The most agreeably lighted hall the author ever entered was one where cheesecloth had been tightly stretched under the four or five chandeliers of brilliant electric lights. Without the cheesecloth the light was bright but not agreeable.

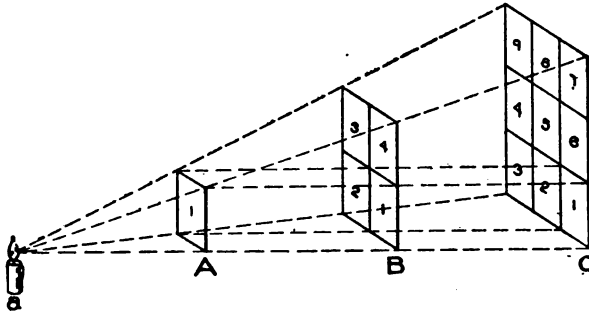
**Sudden
Changes**

Sudden changes from intense light to darkness, or vice versa, cause great strain to the eye. It is not wise, then, to have only a local light furnished for work and all the rest of the room in darkness. There should always be a low general illumination of the room, so

that when the eyes are raised, the changes of intensity may be gradual.

For purposes of reading or near work, bright light is necessary, but it should be directed to the object, and not reach the eyes. This local light should there-

**Local
Illumination**



"THE INTENSITY OF LIGHT VARIES INVERSELY AS THE SQUARE OF THE DISTANCE."

If A is one foot from a, B two feet and C three feet, the light will be one-fourth as intense at B and one-ninth as intense at C.

fore be shaded by some material which will reflect light from the surface next the flame, while it is dark on the surface next the eye. When one light furnishes both general and local illumination, a white shade may be used, but a shield should be placed either over the eyes or between them and the light. It is very harmful as well as disagreeable at any time to look directly at the flame.

A light may be well diffused but not strong enough; or it may be affected by air currents—little gusts of

wind, which make it flicker. A good light will be strong and steady.

**Heat
with
Light**

Natural light from the sun has no other harmful effects except those which apply to the eye, although in summer we often desire to separate the light from the heat. This is partially done by window glass which is more permeable to light than to heat rays. Artificial light furnishes a similar trouble. There is no source of artificial light directly due to combustion which is not also a source of heat. None of them give more than one or two per cent of the energy as light. If we could use the heat just where it was needed, all might be healthfully and economically arranged, but usually it is added to an already sufficient quantity. The first danger in all artificial light is this excessive heat.

**Amount
of Oxygen
Consumed**

Then all sources of light due to direct combustion use up oxygen and add to the air the usual harmful products of carbon dioxide and moisture, with other more or less objectionable gases, dependent upon the kind of fuel. One ordinary gas jet uses as much air as two persons, while a kerosene lamp takes as much as four. All these combustion products should be carried away near their source, while hot, or diluted with large quantities of fresh air by ventilation, as we have already seen.

**Local
Ventilation**

It is possible to arrange flues or ducts above fixed lights which will serve as outlets for these hot, impure gases. This is done in halls, churches, theaters, and in some private houses, by ornamental gratings over

chandeliers. These are the openings to ducts passing between floors or upward to the outside air. The hot air currents within the ducts tend to withdraw all the impure air from the room.

The fuels which now furnish artificial light are commonly the liquid mineral oils, kerosene, gasoline; the solid fats, tallow, spermaceti, paraffin in candles; or gases of different kinds.

**Lighting
Fuels**

Although chemistry teaches us that both the candle and the oil lamp are gas factories and the flame in both cases is really burning gas, there is a difference in the method of combustion. The candle and oil take oxygen from the air to combine with a wick which draws the liquid fuel to a place where under the influence of the heat it can be vaporized and ignited. The solid candle uses more oxygen than the liquid kerosene for the same amount of light, while gas uses less than either. The amount of carbon dioxide given out by candles is considerably more than with oil, and more than double that with gas. Candles now are seldom used, except for artistic purposes when full general illumination is desired. When used, more fresh air should be supplied to furnish the necessary ventilation.

The kerosene lamp is a common source of light, and with the best oil, good burners, proper care and the flame properly shaded, it is healthful if the rooms are ventilated. Without good ventilation, unhealthy conditions will prevail.

**Kerosene
Lamps**

To ensure safety, as well as a strong, steady light, the kerosene must be of a high grade, well purified, kept in clean cans protected from dust or water. There is great danger of explosion, as well as very much less light-giving quality from a low grade kerosene. The burner should allow sufficient air to gain access to the wicks to ensure complete combustion and create a current which will carry all products upward away from the wick. The air holes and the wick tubes must be kept free from dust and dirt. Burners should occasionally be boiled in soda and water. They must afterwards be thoroughly dried.

**Air
Supply**

The air may be supplied to the sides of the wick as with single or double-flat-wick burners or to the inside, as in the circular wick. Chemistry teaches us that the combustion is more complete in the latter condition. There is less danger of smoke, but there is greater heat. If the lamp or the eyes are not shaded, there should be an opalescent glass chimney.

**Safe
Oil**

The only safe kerosene to burn is that of a high flash test, at least 100 deg. F. Some state laws require an oil of 150 deg. F. flash test; 120 deg. F. is a good medium oil. The large burners and reflecting shades raise the temperature of the oil in the tank to a point which with low grade oil would be dangerous.

A thermometer held between the shade and the chimney, compared with one just outside the shade, will show one source of the high temperature in the tank.

Lamps should be filled daily and nearly full, so that there shall be no large space between the oil and the burner in which gas may collect. If filled too full, the oil expanding under the heat will ooze out and, if ignited outside, may prove dangerous. It certainly is unclean. After the lamp is filled the wick should be turned a little below the edge of the burner. This protects the wick from dust and air and prevents the running over of oil by reason of the capillary action of the wick.

Care of
Lamps

Oil lamps without extinguishers, and stoves should be turned down and allowed to go out of themselves. If not, a sudden whiff of air *across* the top of the chimney may be given. Never blow *down* a chimney. There is danger that the flame may reach the explosive gas or even touch the oil.

The healthfulness of gas depends upon its purity, the character and condition of pipes and fixtures, and the products of combustion. Being an open flame there is also less steadiness. It is, however, a fixed light and always ready, therefore convenient. Illuminating gas is of two kinds—the ordinary coal gas and water gas. The first is a product of the distillation of coal, the other made by decomposing steam by means of white-hot coal or coke. Illuminating coal gas contains a number of gases, chiefly hydrogen and hydrocarbons. It has a small per cent of carbon monoxide which is its most dangerous ingredient.

Illuminating
Gas

Mixed with a certain per cent of air it is highly explosive.

**Water
Gas**

Pure water gas contains hydrogen and a very large proportion of carbon monoxide. These in burning give only a pale blue flame, consequently the gas has to be mixed with hydrocarbons before becoming luminous. The carbon monoxide has no odor, but the hydrocarbons added give to the gas as used much the same odor as ordinary coal gas. It is far more poisonous and becomes dangerous *long before* the odor might cause suspicion. Recovery from such poisoning is less likely than with ordinary gas poisoning, for the monoxide combines with the blood, depriving it of its oxygen and preventing it from performing its work. The brain is also seriously affected. Water gas is by far the most dangerous pollution that the air of the house may receive.

Acetylene

Acetylene, another gas common in some sections of the country, is made by the action of water upon lime and coke. It has a large proportion of carbon, which needs more air than the ordinary gas burner supplies. It requires a special tip and then the flame is fifteen or more times as brilliant as ordinary gas. The light is intense, very white and must be well shaded. With careful preparation and under proper management it is probably as safe as any gas, and gives a light very much like daylight.

Where any piped gas is used there is danger from leaky joints or fixtures, and any such leak pollutes

the air. The poisonous effects of slight amounts are slow in manifestation, but extremely debilitating. When the odor is detected it should be traced to its source and the defect at once remedied. If a strong odor is found the room should be aired before a light is used, whether lamp, candle or match, as an explosion might result. Even sparks from the workman's tools have caused ignition of escaping gas. If there is a strong odor, windows should be opened and the gas shut off at the meter. Then, after a while, a light can be safely used.

There are many more leaks around burners, keys and fixture joints than in the pipes themselves, but these are more easily detected and remedied. If very obscure, cover the joints with soapsuds and the escaping gas will produce bubbles, which indicate the leak. A little hard soap pressed around the crevice may seal it until it can be permanently repaired. General debility in the house plants often indicates a condition unsafe for human beings.

Anything which prevents complete combustion interferes with the light and increases the harmful products. The burner should burn all the gas which passes through it. It must then be of good pattern, Fig. 28, and furnished with a tip which will cool the flame as little as possible. The lava tips answer this require-

**Leaky
Fixtures**

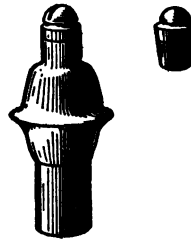


Fig. 28. Gas Burner and Lava Tip.

**Gas
Burners**

ment better than those of metal, Fig. 28. The orifice in the tip should be kept free from dust or any foreign substance, as a very little obstruction will obstruct the free flow of gas, prevent a full flame and may allow some gas to escape unburned. When a gas burner "whistles" unburned gas is escaping. This is bad for both health and the pocketbook.

**Lighting
the Gas**

In lighting gas the match should be ignited and placed over the burner ready to apply before the key is turned, that no chance be given for escape or waste.

Fixtures with many bends or scrolls often accumulate deposits which interfere with a free flow of gas and obstruct the openings. Efficient light, economy and beauty are combined in fixtures of simple pattern.

Gas Cocks

Fig. 29 shows a gas key and its construction. No key should ever be allowed without a stop pin or peg to prevent the key being turned a little too far. These faulty keys are not allowed in new houses, but are sometimes found in old fixtures. Occasionally this stop peg falls out. No risk should be run, but a small nail or screw put in, until a new peg can be inserted. It is possible that more lives are lost from this defect than from the blowing out of the gas.

Drop Lights

Drop lights are very likely to leak at the fixture or the burner. Only the best grades of tubing should be used. Most rubber deteriorates rapidly and will allow the gas to pass through. An old pipe should be carefully watched with this danger in mind, and discarded

the moment it is not above suspicion. Drop lights should always be turned off first at the fixture, then at the burner.

Globes should be large at the bottom, Fig. 30, to allow free passage of air around the flame and upward, to prevent unsteadiness. The principle of diffusion by prismatic glass is applied to globes and shades. They are made of glass cut in different angles in different directions so that the light may be thrown down for reading, up to the ceiling, or out into the room.

Fuel may be burned to raise certain substances to so high a temperature that they will emit light. This is the principle in the Welsbach and other burners, where a thin gauze or other cloth is treated with certain chemicals capable of resisting the high temperature, Figs. 30, 31. By their use a much brighter light is obtained with very much less gas. Only about one-third as much gas per candle power is required, therefore heat and impurities are diminished. However, the flame is so intense that very careful shading is required. The naked flame should not be used, neither clear glass globes or shades.

In electric lighting the force is obtained either from storage batteries or from a central dynamo. The house is wired and small lamps containing a carbon filament are adjusted to these wires so that by turning a key



Fig. 29. Gas Key with Stop.

Globes

Incandescent
Mantles

Electric
Lighting

or pressing a button the two wires are placed in contact and the circuit is completed through this carbon coil. This offers resistance to the electric force and heat sufficient to raise the filament to a luminous temperature results. The air inside the bulb is completely exhausted so the carbon filament does not burn. There are here no products of combustion, no fluid or gas to leak out and the heat produced in comparison to the light is very small. The light is intense, but the bulbs can be made of opalescent glass, which will diffuse while it prevents any glare. The little lamp on flexible wires can be placed anywhere and therefore all parts of a room may be uniformly lighted. It is, no doubt, the most sanitary system which is at present available. In some places it is cheaper than gas or oil, but generally its expense is greater, from one-half more to twice that of either of these. However, the house by that expense will be more efficiently and healthfully lighted.

Dangers

The dangers from any lighting system, except electricity, are the products of combustion, the waste heat, the possible leakage or unburned substances, and the danger of fire or explosion due to the breakage, nature of the fuel or carelessness in handling.

**Lamp
Turned
Low**

A lamp should not be left long turned low, as the burner of the lamp is proportioned to the full supply of air and the low flame will be cooled below the point of complete combustion, so that the carbon monoxide will be formed instead of carbon dioxide, or the wick,

being turned so low into the burner, not all the gases formed are burned and disagreeable odors result.

When gas is turned very low there is danger of the flame being extinguished should the pressure, for any reason, be lowered. If the pipes are too small, turning on a fixture on the same line may put out the light and allow the gas to escape freely thereafter. A

**Gas Light
Too Low**

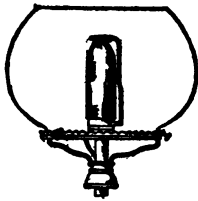


Fig. 30.

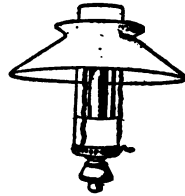


Fig. 31.

INCANDESCENT MANTLE GAS FIXTURES.

draft of air may have the same effect. Sometimes the Bunsen burner of the Welsbach light or the gas stoves "burn back" if turned too low or not properly lighted; that is, the gas burns not at the top of the fixture, but inside, where the gas is mixed with the air. The combustion is not complete when this happens, and acetylene with other poisonous gases are given off. The remedy is to turn off the gas and light it again.

Electric wiring should be very carefully installed, and then, with reasonable care, there is little danger from fire. However, certain precautions should be observed, for under certain conditions heat is gen-

**Electric
Wiring**

erated sufficient to set fire to inflammable materials with which the lamps come in contact. To prevent some of the dangers the following suggestions have been approved by insurance authorities.

**Suggestions
from
Insurance
Authorities**

When through with a light, turn it off; this economizes in the current as well as ensures greater safety.

Knots should not be tied in the flexible cords; this shortening of the coil increases the resistance and results in more heat. These flexible cords, too, should not be hung on metal of any kind, nails, gas pipes, etc., nor allowed to become wet.

Inflammable materials are not suitable for shades. This is artistic as well as sanitary truth. The suggestion of flame coming from a paper or lace flower is contrary to the law of appropriateness. Things should not only *be* safe, but should *look* safe.

Inspection

Wherever electric wires for lighting are introduced there should be rigid inspection before the current is turned on. If the insurance inspector accepts the work there is the strongest assurance of safety. A careful watch, however, should be kept that no insulated places become worn; or that the exposed wires are not subject to contact with metal or any wet surface.

WATER

Most persons think that food is the primary need of the body. We have learned from chemistry that carbohydrates, fats and proteids do not furnish us food without air. Physiology and chemistry both show us that water is also a primary need of the body. Indeed, life can exist much longer without food than without water. Not only is water necessary to the vital processes for drink, and in the preparation of food, but also for cleansing purposes, first to the body itself and its clothing; next to the house and its furnishings.

For the first uses, it is of prime importance that the water contain nothing harmful to the body; and for cleaning purposes outside the body that the water used shall do its work thoroughly, quickly and leave no injurious matter behind.

Certain dissolved mineral ingredients—lime and magnesia—make some waters “hard” as compared with others which are called “soft.” The hard waters sometimes cause intestinal troubles, but this depends largely upon the “habit” of the persons using them. A person accustomed to soft water may be made ill by drinking any harder water and *vice versa*.

**Hard and
Soft Water**

The hard water interferes somewhat with solubility in cooking, therefore more time and fuel are used. Perhaps its chief interference in the health of the household is in laundry uses; making necessary a large

expenditure of soap, of water to remove the soap, and of the strength and the time of the housewife. It is much more difficult and expensive to have clean fabrics where hard water must be used. Health and economy are best served, under these conditions, by catching rain water for purposes of cleansing. All such barrels or tubs, however, will at the proper season serve as mosquito hatcheries and should therefore be kept covered with cloth to prevent the entrance of the mosquito, but not to exclude air; or the surface of the water may be protected by a thin film of kerosene. If the water be drawn from the bottom of the barrel the oil will not interfere greatly with the cleansing processes. If such storage places are tightly covered they will smell badly.

**The
Rain Water
Barrel**

Because of the great importance of water, both for purposes of drink and cooking as well as for cleansing, it is necessary that it be supplied generously and be easily accessible.

**Supply
Generous
and
Accessible**

Saving in the use of water is too often the cause of ill-health and unsanitary conditions of body and house. This saving may result from actual lack of water furnished, as in seasons of drought, or because of the excessive labor required to bring it where needed, as in many a farm house still served by the well-sweep or outside pump.

There are few places where a permanent home cannot be supplied with sufficient running water at com-

paratively small expense. It is false economy which often spends for the barn and cattle and not for the house and family. Many houses might be supplied with never-failing running water in kitchen and simple bathroom at the expense of a small amount of piping and a few days' labor. Where a high natural source is not available, water may be raised, periodically, by windmill, force pump, or engine to a large supply tank, or one day's supply may be stored.

A generous, convenient supply of water should not be considered a luxury possible only to a few, but a necessity obtainable by the many even at the cost, if need be, of some other less important furnishing.

**A Necessity
Not a
Luxury**

To have it is a necessity; to have it harmless is of equal importance. This in many situations is the more difficult problem.

Neither looks, taste, clearness nor opaqueness can be trusted to distinguish between a safe or an unsafe water. Indeed, that which is most objectionable often has a "sparkling taste," is clear, cold and in every way attractive. An intelligent woman whose house had two supplies, one known to be safe, the other under suspicion for drinking purposes, remarked that she often took a drink of the latter because it was so "much colder and richer"!

**Impurities
and Their
Sources**

The suspended matter may be entirely harmless, although it make the water muddy and unattractive; soluble organic or inorganic substances may not affect

the color, taste, odor or clearness, while the water may at the same time be charged with disease germs.

**Diseases
from
Water**

There are not many diseases which are liable to be caused by water-borne germs. Those which affect the intestines are most likely to be carried in this way, because the germs are present in their discharges. Typhoid fever and Asiatic cholera have been traced to such sources so often that their frequent connection with water supplies is considered proved; while it is more than probable that dysentery and other diarrhoeal conditions may be spread in the same way.

**Impurities
in Rain
Water**

The condensed water vapor of the atmosphere is the original source of all our water supply. As this water vapor condenses round particles of dust, the *first* fall of any shower must necessarily be dirty, whether it contain living organisms or not. Snow in sifting through the air takes to itself even more of the dust particles than the uncongealed water. As the rain or the snow washes trees, houses, animals and all other objects it becomes more and more laden with dirt of a miscellaneous kind. Among all these there must doubtless be many disease germs which, carried by the air, have lodged upon these places.

It also takes to itself many gases which have been carried into the air from manufactories of varied kinds. With this content of dissolved gases and solid dusts, the character of the water when it reaches the earth is greatly changed from that it had at the start as pure oxygen and hydrogen.

Some of these gases enable it to dissolve mineral matters from the rocks and soil as it runs over the surface or soaks down into the earth.

The immediate sources of house water-supply, then, may be considered as three:

1. Rain or snow water caught — and stored in cisterns in the house, outside, or in the ground.
2. Surface waters, brooks, rivers, lakes, ponds, some springs and dug wells.
3. Ground water—most wells whether dug, driven or bored, some springs.

The first source we see might be dirty, but have almost no danger of contamination from any sewage products. The first water falling should not be allowed to run into the cistern. This will keep out the most disagreeable and dangerous dirt—small insects, droppings from birds, or even birds themselves washed from roofs and gutters (there are automatic devices in use for this purpose). Such rain water should be carefully filtered, and this may be done in the cistern or in small filters as desired. Fig. 32 shows one form of ground cistern used for rain water supply. The water is received into one part, filtered at the bottom, where

Sources of
House
Water
Supply

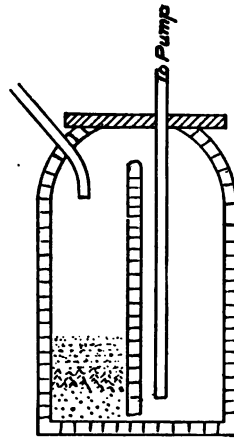


Fig. 32. Ground Cistern with Filter.

it then passes into another chamber, with which the pump connects.

Cisterns

Cisterns used for storage should be made of slate, vitrified brick or wood, lined with tin or cement, provided with an overflow pipe discharging into the open air or by open end over a sink, and should be constructed so as to be inspected and cleaned occasionally.

Wells

An ordinary well is a hole dug in the ground until water-bearing layers are reached. A place is then scooped out to furnish sufficient depth for collection

and storage. Very often the sides are simply laid with rough stones to prevent the dirt from caving in.

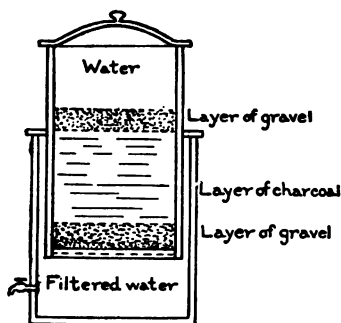


Fig. 33. A Portable Water Filter.

There can be no universal rule as to the area of soil drained by a well. The more water used the greater drain upon the soil, so that this factor is of more importance than mere depth. However,

the shallower the well the more liable it is to pollution, either constant or temporary. The householder may carefully locate his well with reference to his own land and sewage, forgetting those of his neighbors. It is often thought that a well placed higher than any

known source of pollution is safe, but it is not the outlet of either which is to be considered but the possible place of entrance. In Fig. 34, *a* is shown to be this

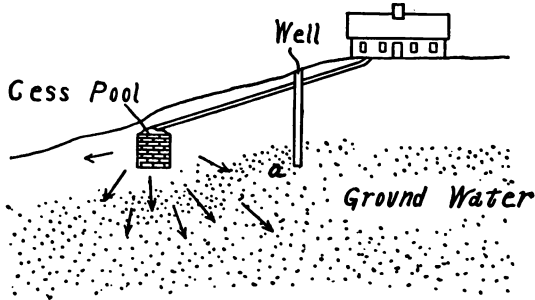


FIG. 34. A WELL CONTAMINATED BY A CESS-POOL AT A LOWER LEVEL.

danger point, while Fig. 35 shows how the positions might be reversed without danger.

The filtering power of earth is very great, and

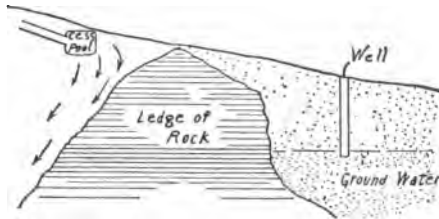


FIG. 35. A WELL MADE SAFE BY AN INTERVENING LEDGE OF ROCK.

through it many an infected water becomes safe before reaching the consumer.

**Surface
Infection**

The infection from the surface is perhaps the real danger, while it is one which is usually overlooked. It is possible that side or bottom pollution will be prevented unless there be cracks through the ground or the rocky strata which allow the water to run into the well without filtering through the soil. It is more than possible, it is even probable that most pollution comes from the surface and through these cracks or fissures.

The well drawn by a pump is often covered with boards so loose as to allow cracks through which the waste water washes more or less dirt at every period of use—insects, leaves, filth of many kinds from the boots of those drawing the water, or from the feet of passing animals.

Cattle are often watered at the trough fed by this waste water; hens track over the boards, and both are likely to carry filth from barnyard, pasture, and privies. Toads, moles, etc., tunnel into the cool moist soil and may fall into the water. The well may perhaps not be used for the household purposes, but only for the cattle, for washing milk-cans, etc; but there is still danger. If disease germs are present such water is dangerous, whether used directly or for cleansing purposes. The well to be safe must be thoroughly protected from all pollution from the top.

**Safe
Distance**

Just how far a well may be from a source of infection and still be safe cannot be told in figures, for it depends upon the direction of the flow of the under-

ground water, its force, and the position of the strata of rock or soil about the infected quarter. If all water for some distance drains away from the well it is not likely to be infected, but this cannot be told for all times and conditions.

To find out whether a well is polluted by drainage from a certain point, as the privy or cesspool, a quantity of the easily diffusible coal-tar colors may be put into the latter. If the color appears in the well-water it shows the current is flowing that way. Fluorescein is often used for this purpose.

Tests for Drainage Pollution

Although there may be no danger in drinking sewage contaminated water so long as actual disease germs are absent, there is no way of telling when these may appear. Typhoid fever is not always recognized until long after the discharges might pollute the well, if they entered as drainage from polluted land.

Sewage polluted waters, too, are rich food for many kinds of organisms, which may multiply to such an extent as to increase the risk.

A good well will be lined as far as the water bearing strata with cemented vitrified brick, or stone, cement alone, or with sections of terra cotta tile tightly joined together.

A Good Well

The top or curb will be raised from six to ten inches, the opening covered with stone, and the sides cemented to slope far enough away from the opening to prevent any pollution from dirt or washings. Some place to allow inspection and cleaning should be ar-

ranged for and covered tightly. All wells should be opened and cleaned occasionally. If any slime be found it is evidence that organic matter is present, coming in probably through the imperfect lining or from surface pollution.

If a pump is attached, convenience directs that the pump should be in the house, drawing the water through pipes, if necessary.

Water Pipes

No material for water pipes in any place should be used which will give harmful substances to the water. But this, too, cannot be decided for all waters. Some waters dissolve lead, while others do not. New lead pipes may be attached which after use become harmless. Iron pipes rust, and thus soil the water for

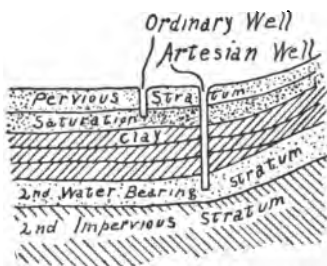


Fig. 36. Section Showing Ordinary and Artesian Wells.

laundry purposes, even if they do not make it unhealthy.

Tin-lined iron pipes seem to combine strength and sanitation, but are more difficult to work than lead. The pipe which stands in the well should not be of lead; but the small connecting pipes may be, and the water will be safe if that which has stood for some time in the pipe be discarded and all used for drinking

W. H. O.

and cooking be taken from the lined iron pipe below. Wooden pipes are safest.

Figs. 36, 37 show types of driven or tube and bored wells. They explain themselves. Such wells are usually safe from all surface washings and if the ground water be at considerable depth the tube well will not be liable to pollution from unpurified sewage. The bored well is practically safe from all such pollution, but its water is apt to be hard.

It is seldom safe to use the well as a refrigerator, as is often done. There is always danger that in the frequent opening and closing of the well for the admission or removal of food; some objectionable matter will fall in. Let a hole be dug for the cold storage, if desirable, but do not use the drinking-water well. An open or temporarily closed well is in constant danger of pollution.

Driven
Wells

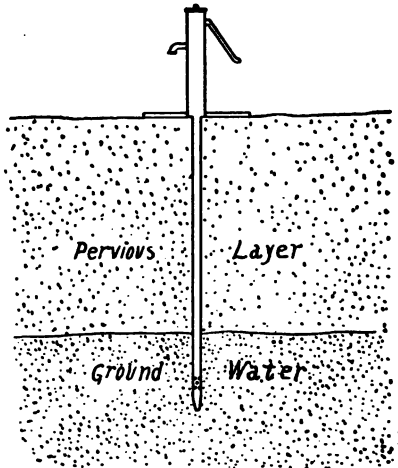


Fig. 37. A Driven Well.

**Sewage
Pollution**

The mountain brooks running over gravelly or rocky beds, through forests or large uninhabited or sparsely settled regions are ideal sources of water, but they may lose their purity whenever man settles near them. They are liable then to receive the direct drainage of the manured fields or the wastes from sinks, privies, stables, pigpens and barnyards. It is the danger from human wastes and other sewage which has not been subjected to the bacterial scavengers in the soil until changed over into inorganic elements that make these running streams unreliable, if not actually unsafe sources of water.

**Natural
Purification
Takes Time**

It is often said that "running water purifies itself." True it is that light and sunshine have a germicidal action and that some of the suspended matter will be caught or settle, but the more rapid the stream the less the action of such purifying agencies. Not many years ago a case of typhoid fever occurred. The excreta were thrown out on the snow forty feet from the house near a stream which furnished drinking water for the village. The snow melted a few weeks later. An epidemic started which ended in over one hundred deaths from more than one thousand cases.

Open water supplies, like lakes or ponds, which are comparatively quiet and which expose a large surface to the light, may become in time purified from suspended matter or organic life; but none of these forces or all of them together will remove the soluble ingredients.

It should be made a criminal offence for any indi-

vidual or town to endanger life by using these possible water supplies for the reception of sewage.

If a safe surface supply is available it should then be safely piped to the individual house.

A spring is often considered synonymous with safety, so far as a water supply is concerned. It is plain to be seen that springs are as liable to pollution, either at the source or below, as any other supply. Even if the ground-water spring may be trusted, its outlet must be protected from pollution.

Springs

If the house be supplied from a distant ground-water source, any storage basin should be *covered* to keep out light. These waters are not expected to have vegetable life in them, but uncovered they will become seeded, and on their mineral ingredients such plant life flourishes. Surface water tanks should be *open* to hasten the death and decomposition of the low vegetable life always present.

These sanitary principles are equally applicable to public supplies and every householder should know the character of the supply with which she is furnished.

Many housewives use small faucet filters, thinking that because the water which issues from them is clearer than that which enters, it must therefore be safe. Clearness, as we have seen, is no sure guide to purity. A flannel bag on the faucet will strain out suspended matter and can be changed often. A little charcoal in it may remove disagreeable odor and objectionable color. Charcoal can be washed and baked

Filters

to kill all living forms strained out; but neither these or any other filter can remove dissolved substances. Only filters of fine clay or porcelain will remove the bacteria or their spores, which are the cause of water-borne diseases.

Fig. 38 shows one form of porcelain filter tubes. However, these tubes must be removed and scrubbed and baked or boiled once or twice a week, else the bacteria will grow through the pores and render the clay ineffectual. No filter will strain out these microscopic bacteria rapidly and continuously.

Safe
Drinking
Water

Wherever water must be used which is suspected, of unknown character or known to be polluted, it should be boiled for half an hour, aerated by pouring at a height from one clean vessel to another, in a *clean* place, then covered from *dust* and stored in *clean* places. It may be poured through a sieve or allowed to run slowly through a long pipe from a high place to a lower dish.

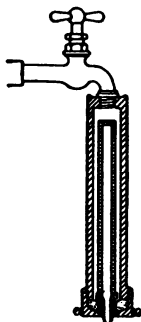


Fig. 38. Porcelain Water Filter.

Distilled water, which is really condensed steam, is pure. To remain so, it, too, must receive clean storage. It is not always favorable for use as a constant drinking water.

"Pure
Spring
Water"

The use of "spring waters" for drinking purposes should be carefully regulated. They are not always the safe waters they are advertised to be, as we may readily suspect from our knowledge of the dangers

of pollution. They are not always collected under sanitary conditions or stored in clean receptacles. The cautious housewife, knowing the dangers, will not put implicit faith in all commercial supplies.

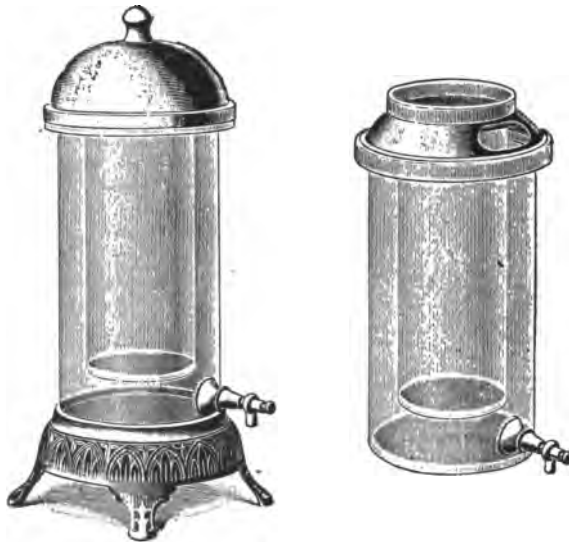


FIG. 39 A TWO COMPARTMENT ICE WATER TANK.

One small storage place for water which may be polluted is the ice-water tank. Not only may the tank become coated with slime on its interior surface, but the ice put into the water may actually infect the water.

Ice-Water
Tank

Ice from polluted water may or may not be purified during freezing. Crystal clear ice is usually pure, but

Ice

snow or bubbly ice should be suspected. However, ice should not come into direct contact with our drinking water any more than with other liquids or food. All may be ice cold and still safe from any danger from the ice. If convenience require, let the ice tank have two compartments. Fig. 39. A clean water-tight pail holding ice might be placed in the water.

HOUSE WATER STORAGE

With a safe water supply the housewife has only to be sure that the conveying pipes do not injure it; that any cold water storage tanks are safe, and that both they and her hot water boiler are kept clean.

Water Supply Tanks

Most houses now draw the water for drinking and cooking directly from the street main—a direct system—using the tank in the upper part of the house to fill the hot water boiler and sometimes the water-closet flushing tanks. Old houses and some new ones have an indirect system where all the service, both hot and cold, is from this house tank. There are dangers connected with each, but the direct system for the cold water is considered the more sanitary. These house tanks are often placed in dark, inaccessible positions and are therefore seldom, if ever, looked at except by the plumber, when repairs are called for. The housewife must keep this tank covered, inspect it occasionally and clean it when necessary. All stored water contains or collects organic matter and dust. These form slime over the sides and bottom of the tank. The tank should occasionally be emptied and scrubbed

clean. It must then be allowed to refill before any large amount of water be drawn from the hot water boiler. These tanks are sometimes of slate, but usually of wood lined with tinned copper. The mechanical action is that of a ball cock valve. Fig. 40.

The tank should have an overflow pipe which empties either out of doors on the roof or by a pipe opening over some fixture, as a bath, basin or sink. It must not be connected with the sewerage system.

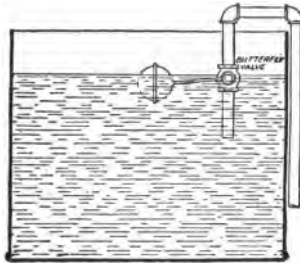


Fig. 40. House Tank with Automatic Shut-Off Valve.

If this tank be liable to freeze, it should be packed with hair, felt, shavings or cork.

In new houses both cold and hot water service pipes are often of brass. Lead is common because cheaper and easily worked. There are some sanitary objections to both of these, the danger varying in degree according to the water.

Pipes

Safety is assured if for drinking and cooking the cold water is allowed to run off one or two gallons, until it flows from the street main. The hot water from the boiler should *never* be used for the above purposes, for hot water dissolves both the lead, the copper and some of the brass, to an appreciable extent. All of these are injurious. •

THE HOT WATER SUPPLY

Sanitation and convenience are best served when a generous supply of hot as well as cold water is furnished. This means a storage tank attached to some heating apparatus. It may be the kitchen range, the furnace or other heating system, or a special heater.

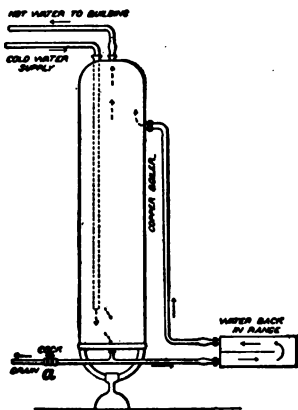


Fig. 41. Hot Water Boiler and Connection.

Ordinarily the water is heated in an enclosed space in front of the fire-box of the range or in pipes running along the front, end or three sides, according to the amount of water needed. By convection, the contents of the boiler are heated and can be drawn from the top and carried anywhere

desired. Fig. 41. Cold water from the house service enters by a pipe at the top of the boiler, passing out at the bottom into the water-front of the range, where it is heated, expands, rises and passes out at the top through a pipe rising directly and entering the boiler near the top. Sometimes there are three pipes seen at the top. The middle one is then the cold water pipe, the other two carrying hot water, one to the sink and

tubs, the other to the upper part of the house. Sometimes there is also an escape pipe from the top of the boiler.

The water will not be heated without circulation. To start and continue this the water must enter the boiler hot. But even then the pipes leading from the boiler rapidly cool the water so that in order to get hot water at any fixture, it is necessary to wait until the cooler water in the pipes runs off and the water from the boiler reaches the faucet. To obviate this long wait and waste of water, at the highest part of the system a small pipe, called the circulation pipe, is connected with the hot water pipe near the faucet and then with the bottom of the boiler. Fig. 42.

The difference in temperature between the water in the supply and circulation pipes assures a continuous circuit of warm water.

As an upward bend in a water pipe will fill with air, which would act like a plug, stopping the flow of

Circulation

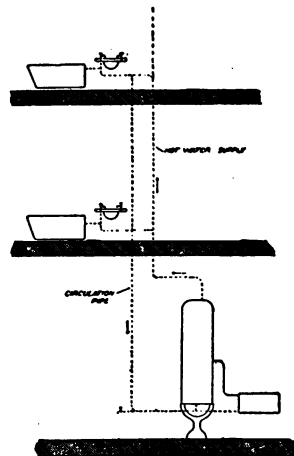


Fig. 42. Hot Water System with Constant Circulation in the Pipes.

**Pipes
Air Bound**

water, an expansion pipe must be carried from the highest point of this circulation pipe, opening in a safe place, preferably above the tank.

**Direct
System**

Where the boiler is supplied directly from the street main this circulation pipe cannot be used; for the pressure being so great, the expansion pipe would overflow. A stronger boiler is required with the direct system.

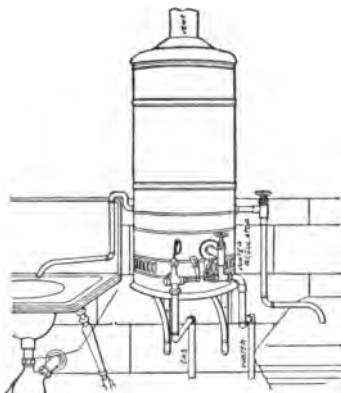


FIG. 43. AN INSTANTANEOUS HEATER.

Sediment

In all stored water, in time, more or less sediment will collect. This should be removed from the hot-water boiler by means of the clean-out cock furnished for the purpose in a pipe extending from the bottom of the boiler. Fig 41a.

It is safer to do this before the fire is built in the morning, and the water should only be allowed to run until it flows clear.

Disastrous explosions have sometimes occurred from starting a hot fire in a stove when the water in the water front and connecting pipes has become frozen. With the pipes full of ice, there is no chance for the water to circulate and sufficient steam may be generated to break the water front before the pipes outside become clear. The connecting pipes should be thawed first and then a slow fire started in the stove.

**Danger
from
Frozen
Pipes**

Fig. 43 shows one form of water tank now quite commonly installed in bathrooms. A blue flame gas jet in a few minutes furnishes heat sufficient to heat water enough for a complete bath.

**Instantaneous
Hot Water
Heaters**

WATER TESTS

Water from swamps, stagnant pools and the like, is of course, unfit for drinking. Looks and taste guide us to this extent. To test the water which has been contaminated by house drainage or sewage, much must be known. The chemical examination of water is one of the most difficult and delicate branches of analytic chemistry. The most careful chemical analysis, however, must be supplemented by a bacteriological examination before the actual presence or absence of disease germs is proved.

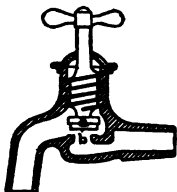
The chemical tests are conducted chiefly to determine whether or not the water has been contaminated by sewage, and how long since the pollution took place. To determine this, tests are made as to the condition

**Object of
Chemical
Tests**

of the organic matter in the water. Freshly decayed nitrogenous materials produce ammonia. After further bacterial and chemical action the ammonia is changed into nitrites and finally into nitrates. By testing for these products the amount of pollution, if any, and the time since it happened, may be usually determined.

**Common
Salt an
Indication**

Another test is for common salt. Water polluted by house drainage contains, although a very small amount, yet more salt than ordinary water. In all cases the source of the water and the ordinary composition of unpolluted water in about the same locality, must be known. This, combined with the bacteriological tests, which should reveal the presence and kind of germs, gives the trained analyst a good idea of the purity of the water.



**Water Faucet.
a, Replaceable Valve
Disk; b, Seat.**

**Tests
for the
Housewife**

There are not many tests which are at all reliable in the hands of an amateur. The sense of taste and of smell are the chief tests which the housewife can apply for water. To find the odor of the water, a large bottle, two quarts or a gallon, may be two-thirds filled with the water, tightly corked and placed in a warm room. After standing for some hours the cork may be carefully taken out and the odor coming from the bottle immediately noted. It is well to shake the bottle slightly, so that the odor may be more clearly detected.

A disagreeable odor of any kind is a bad indication, although it is not proof that the water is at all dangerous.

Another test is to boil about a pint, and note if any bad odor is given off. The boiling may be continued to near dryness, in an enameled or earthenware dish, then the small amount remaining should be transferred to a small saucer and heated to dryness. If on heating the dish hot, there is some charring, this shows that the water contained organic material, and may be dangerous.

**Residue
on Boiling**

The water of large towns is in many cases well and thoroughly tested, and the State or City Board of Health will in some cases make an examination of private water supplies free of charge. Usually, the State Agricultural College will do this on request.

HOUSEHOLD HYGIENE

PART II

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. Leave space between answers. *Use your own words*, so that your instructor may know that you understand the subject. Read the lesson paper a number of times before attempting to answer the questions.

1. Name and give an illustration of each of the ways in which heat is transferred.
2. What are the aims in sanitary house heating; in house lighting?
3. If obliged to use stoves, what unhealthful conditions would you seek to avoid, and how?
4. What are the advantages and disadvantages of direct hot water and direct steam heat?
5. By what systems of house heating are partial ventilation and warmth combined? What is lacking for complete ventilation?
6. When and why should an annual cleaning of a warm-air furnace be done and what should it include?
7. Do you know any unsanitary conditions connected with your heating systems, and how may they be lessened or removed?
8. What would be your choice for a heating system, and why?
9. What unhealthful conditions are connected with gas and oil lighting?
10. What precautions should be taken in the use of kerosene, and how should the lamps be cared for?

HOUSEHOLD HYGIENE

11. What are the advantages of electric lighting and what precautions should be taken with this system?
12. What suggestions have come to you from this study as to efficient lighting of houses in the daytime?
13. What is the most dangerous source of water pollution and what is its especial danger?
14. How can a polluted water be made safe and agreeable?
15. What objections to the use of hard water, soft water, the water from the hot water boiler for drinking purposes?
16. What precautions should be taken if the drinking water is conveyed through lead pipes?
17. How may a safe well be constructed?
18. What sanitary objections to the following:
 - (a) Pools of standing water, or rain-water barrel.
 - (b) In perfectly cleaned salad plants.
 - (c) Bubbly or snow-ice in contact with food,
 - (d) Ice *in* water?
19. What are efficient water filters for suspended matter, for bacteria? Are these effective for matters in solution?
20. As the result of the study of this lesson, have you been able to suggest improvements in the sanitary conditions of your own or some other house? If so, what?

Note. After completing the test sign your full name.

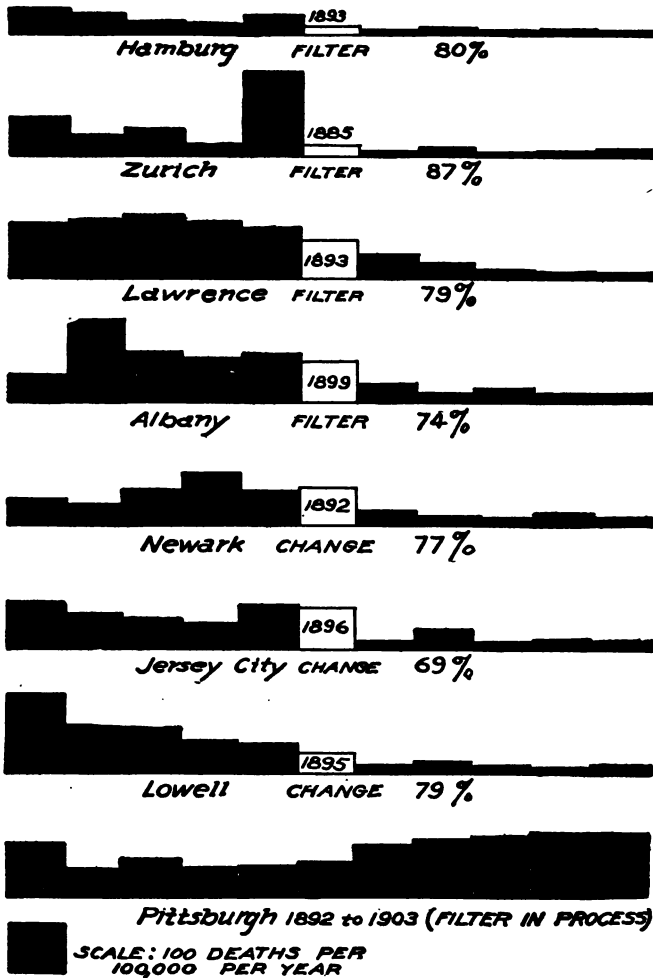


DIAGRAM OF DEATH RATE FROM TYPHOID FEVER FOR FIVE YEARS BEFORE AND AFTER CHANGE IN WATER SUPPLY

The mortality in typhoid is about one case in twelve.

Courtesy of Mr. Allen Hazen, Sanitary Engineer, New York City.

HOUSEHOLD HYGIENE

PART III

THE WASTES OF THE HOUSE

Although we are taught that everything in the world has some use, another fact is equally true, that at some time each article loses its usefulness. It may be of use to somebody else or it may be made over into another useful article, as when the tin cans from the dump are cut into toys or the cinders from our stoves are mixed with cement for floors. To all articles there comes either the wearing away of substance or the completion of usefulness in a certain place for a certain time. They should then be disposed of. If it be known where they can be of use, let them go there. If none can serve any known useful purpose, destroy them, not simply throw them out without regard to other human beings.

**The
End of
Usefulness**

If such useless furnishings of the house are stored, they interfere with the amount and purity of the air, they collect dust, they invite and encourage insect pests and they gradually deteriorate by the action of air, light and moisture. It is not conducive to the health of the family and is therefore uneconomical to keep that which has served its purpose.

**Useless
Furnishings**

Many of our possessions are valued for their associations. Sentiment is a strong moral force, but it

too often is encouraged at the expense of health or benevolence. Attics, closets and storerooms need to be carefully looked after from both sanitary and ethical standpoints.

**Classes
of Waste**

The two great classes of waste in the house are those of animal and vegetable origin which we call organic, and all the rest which we call inorganic. These may often be closely connected as in the bottles and cans which hold food supplies.

**Inorganic
Wastes**

The inorganic—ashes, tins, bottles, iron, and all mineral or metallic wastes are usually useful for other purposes and are not subject to any decay or changes detrimental to health. They, however, hold dust and, where room is at a premium, they occupy space which could be used more economically or left vacant for air. Unless their possible usefulness exceeds the value of the space they occupy and the time and strength required to inspect and care for them, they should not be stored.

Ashes

In most places wood ashes are valuable as fertilizer or deodorizer, while coal ashes may be mixed with earth for the earth closet; with cement for cellar floor or walls; made into walks; used to fill low places, etc.

Because of dust, as well as danger from fire, it is wise to have ashes stored either in brick bins in covered metal barrels, or outside the house, protected from rain.

The best use of all waste is a puzzling economic problem, but the housewife should consider no method economical which threatens health.

The heaps of old tins, bottles, broken dishes and similar miscellaneous refuse often seen about houses in country places may not be directly a menace to health but they are to the happiness and comfort of travelers. These broken receptacles often hold water in which mosquitoes breed and infest the whole neighborhood. Let such refuse covered with a little earth be used to fill low places about the fields, but do not place them uncovered along the roadsides.

**Miscellaneous
Refuse**

Fire is a great purifier and to it may be wisely committed all combustible waste.

All food materials will burn readily when freed from water. Many housewives first dry on the back of the stove, in the ash pan or in the oven and then burn all their garbage in the kitchen range or furnace. In some country houses where only gas is used for fuel, an old stove out-of-doors is devoted to waste disposal, or a crematory is constructed for the purpose. This may be simply a kettle resting on stones under which a fire can be built.

**Organic
Wastes**

In the city under similar conditions, however, it is very difficult and, everything considered, collection may perhaps be the only feasible method.

**Food
Wastes**

Fresh food wastes are no more harmful than the edible portion. It is when these are stored in unclean places or so long that decomposition sets in that danger appears. The cold of winter may delay this sufficiently, so that forty-eight hours storage would not be objectionable, but in summer a daily collection is neces-

sary. Where the collections are not sufficiently frequent, it is the more important that all garbage be stored outside the house in smooth, impervious receptacles which must be thoroughly cleaned and sunned when empty. These receptacles, too, should be covered and entirely protected from attacks of rats, dogs, cats, etc. Bits of garbage carelessly dropped around the receptacle attract these animals as well as encourage insect pests. Whatever utensils receive the wastes in the house during the day must also be carefully washed and scalded daily, that no putrefactive bacteria find bits of food for their growth. The garbage pail should never be unwholesome.

**Burying
in Soil**

Where there is garden soil available, all food wastes may be buried, for bacteria are usually plentiful enough to the depth of a foot to effect decomposition if they are not fed too generously. There should be several places of burial, not one. At a safe distance from the house and the water supply a compost pile may be allowed. Here all solid wastes may be deposited and covered with earth or lime.

**Domestic
Animals
as Scavengers**

Where animals are kept, much of the food wastes should be fed to them. The pea-pods, corn husks, potato parings, scraps of meat, etc., have much nutritive material which should not be wasted. All this, however, should be in a fresh condition. Cows, swine, hens, animals which furnish food for man—should not be fed on putrid matter.

In cities where the housewife depends upon public methods of waste removal, she should learn the special laws of that city and lend her aid to their enforcement. Whatever divisions the health authorities require she should know and comply with. Then, if they do not collect properly or promptly, she has a right to complain and to suggest better methods.

**Public
Waste
Removal**

A good division is—*ashes, combustible refuse and wet garbage*. With the coal ashes may be put all in-combustible refuse not soiled with food wastes.

Man is his own worst enemy for the wastes of his body are the most dangerous to his life. The impure air which he breathes out, the excretions of the skin and its dead particles, the solid and liquid excreta or the wastes of the digestive processes are the portions to which great attention must be given, if he is to have a healthy life.

**Human
Wastes**

Primitive man, like the animals, trusted to earth to render these wastes of digestion harmless; or to the streams to carry them beyond his vicinity. He unknowingly made use of the bacteria in the soil, and their power is as great now as then. The streams are now too valuable as possible supplies of drinking water and should not be polluted.

Wherever there are no sewers, the earth is still available in different ways for the harmless and favorable disposal of these wastes.

The solid excreta or feces, if combined with bacteria-laden earth, that is organic soil, can be disposed

**Earth
Closets**

of without odor. Dry loam is necessary and the whole mass should be kept as dry as possible. Therefore the feces should be separated from the urine so far as is feasible, for the desired bacterial action cannot take place quickly and favorably in a sodden mass where there is insufficient air for these living ferments. Such excreta, too, are valuable for plant fertilization, returning to the soil the compounds which man either directly from plants or indirectly through animal food, has taken from it.

**An
Odorous
Disgrace**

The ordinary privy is a menace to health as well as an odorous disgrace. The excreta in it are exposed to flies which afterward may carry and germs of putrefaction to food or to the house. Other animals may carry them about on their feet. Its watery pools become breeding places for mosquitoes and the washings from its putrefying mass infect the well or other source of drinking water. This is one of the great sources of typhoid infection.

**Impervious
Vaults**

Such privies should be abolished. The leaching vault should be replaced by an impervious receptacle. This may be an oil-soaked half barrel or a zinc-lined box to catch the deposit, or a cemented vault. Their place may be taken by a dry catch privy or by a dry-earth closet of any kind. The bottom of the receptacle may slope toward, or open by a perforated bottom into, a cemented trough for the reception of liquid drainage. This trough may contain sawdust, which is an excellent absorbent of urine.

A still better plan is to receive the deposits into one or more small receptacles placed on a truck which can be removed from the vault without disturbing the contents. Fig. 44. Then if the deposits be kept covered with dry loam the bacteria will carry on decomposition without objectionable odors.

**Movable
Receptacles**

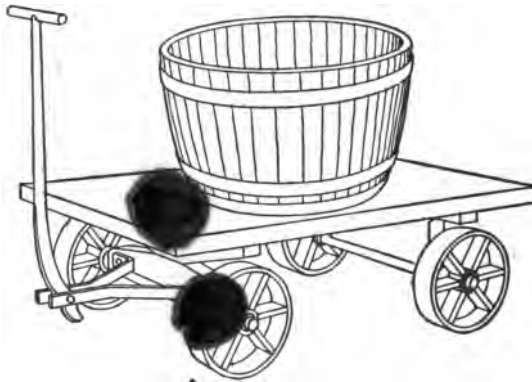


FIG. 44. TRUCK FOR REMOVABLE VAULT.

Fig. 45 illustrates a simple closet and Fig. 46 another, more elaborate, both of which can be used inside the house if properly cared for. The whole box and the receptacle, in this case an ordinary coal hod, in compartment *A* should be kept well painted or otherwise impervious to gases. The contents of compartment *B* may be dry loam or a mixture of one-third ashes and two-thirds loam. Coal ashes should be sifted and only the fine part used. A scoopful, or more, of

**Indoor
Earth
Closets**

this dry mixed material should be thrown over every deposit.

When the organic matter is thoroughly decomposed the whole may be dried, sifted and used again like the original earth.

The final disposal of the contents of these vaults or closets must be governed chiefly by the position of the

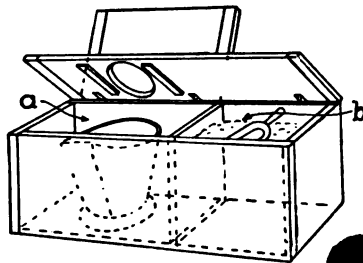


Fig. 45. An Earth Closet.
a, Receptacle; b, Loam Compartment.

water supply. The bacteria will, in time, bring about complete decomposition, but all possible contamination to the well or water supply must be avoided.

Any house in the country may be provided with a sanitary method for the disposal of human waste, if health and comfort are prized beyond a little trouble and small expense.

Kitchen Slops

Next to the human excreta in value as fertilizer and in danger to drinking water, health and comfort, are the kitchen and laundry slops. These contain particles of organic waste which should be returned to the earth and the water used for irrigation. Where there is sufficient land on a slope, the sink spout may be extended to lower ground and its contents empty directly, so long as the soil is not allowed to become saturated.

The spout should be moved to a fresh place often enough to allow the sun to dry and the air to penetrate the drainage plot, that the scavenging bacteria may work favorably. *They must have air to work well.*

**Air
Necessary
for the
Scavenger
Bacteria**

Strong plants, loving rich soil and moisture, may be planted around such outlets. Or, such drains may empty into impervious tanks so arranged that their contents, after settling, will discharge automatically through pipes into ditches or on the surface. Fig. 47 shows one style of settling tank. Occasionally the sediment will have to be removed, and with the usual precautions for the water supply, may be applied as a fertilizer.



Fig. 46. Indoor Earth Closet.

If there be no land available, these slops should be received into an impervious receptacle which can be carried away and emptied in some safe place. Wherever the drain from kitchen sink or a laundry tub or bath empties into a pipe underground, it should be sealed by a trap from any backward passage of gas. Where it empties on the surface this is not necessary unless the pipe is very long. With the trap there is apt to be trouble with freezing. In most sections, however, it may be sunken beyond the frost line.

**Private
House
Sewage
Disposal**

Houses provided with running water should have advantage of a complete water-carriage system of sewage disposal (to be described later), but unless the sewage can be discharged in a public sewer, the ocean, or a tidal river, some system of sewage purification is necessary.

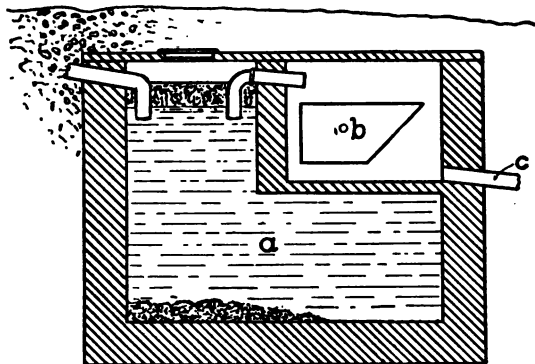


FIG. 47. IMPERVIOUS CESSPOOL ARRANGED AS A SEPTIC TANK.
a, Tank; b, Automatic Discharge Vessel Which
Tips When Full; c, Outlet.

**Leaching
Cesspools**

The leaching cesspool, formerly much used and still too often found, is a constant menace, for there is little purification of the effluent, which contaminates the surrounding soil and often infects some water supply. The impervious cesspool is liable to become a nuisance either by overflow or through the necessity of emptying and cleaning.

A safe and practically odorless sewage disposal plant for the individual house can be constructed at little additional expense—beyond that of an impervious

cesspool. The purification is effected in two stages and by two kinds of scavenging bacteria, the *anaerobic* which work in the absence of oxygen, and the *aerobic*, which must have an abundance of oxygen supplied by the air. The first mentioned scavengers break down the insoluble organic matter in the sewage, converting it into liquid form, which the second set of bacteria may quickly change into harmless substances.

Scavenging
Bacteria

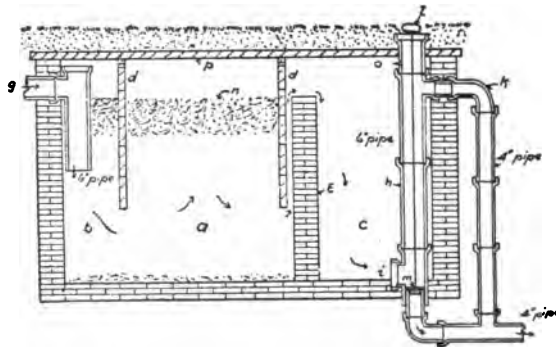


FIG. 48. SEPTIC TANK WITH PARTITION WALL.

Discharged by hand by lifting plug *m* at *l*.

(From Bulletin of Maine State Board of Health.)

The first process is accomplished in the so-called "septic tank," which, in its simplest form, is no more than a covered impervious cesspool with the inlet and the outlet pipes extending a foot or two below the surface of the sewage. Fig. 47. Under these conditions, a scum forms on the surface which mats into a tough mass six inches or a foot thick, thus effectively excluding air and light from the sewage. Provision should be made for the escape of the gases which form,

Septic Tank
System

**Filtration
of Sewage**

for they may be inflammable. The size of the tank should be such that it will hold the volume of sewage produced by the house in twenty-four hours. As nearly all the solid part of the sewage is liquefied, the tank need not be cleaned out oftener than once in three to five years.

The final purification of the sewage is effected through surface or sub-surface filtration. A series of open ditches, to which the sewage from the septic tank is diverted periodically, is the simplest arrangement. Garden crops may be grown between the ditches, thus reproducing in miniature, sewage farming.

The more available method, in most situations, is sub-surface disposal of the partially purified effluent.

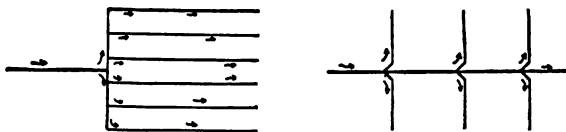


FIG. 49. ARRANGEMENT OF TILE FOR SUB-SURFACE DISPOSAL.

This can usually be accomplished within the limits of an ordinary town lot. Leading from the outlet pipe of the septic tank are a series of common three inch agricultural tile, laid with open joints, in ditches eight to ten inches below the surface. The tile should be laid with a very slight grade and arranged in various ways according to the land available. Fig. 49. From fifty to one hundred feet or more of tile is required, depending on the amount of sewage and character of the soil. In hard ground, cinders may be packed

around the tiles. The surface above the tile may be used for a garden or lawn.

The essential point for the proper purification is to give a period of rest—a breathing spell—to let in the air for the bacteria, after each application of the ef-

Intermittent
Discharge

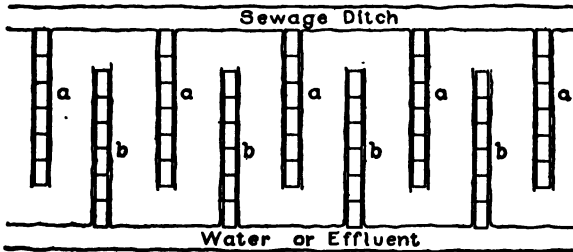


FIG. 50. SEWAGE FILTRATION PLANT.

a a, Lines of Tile which Receive the Settled Sewage; *b b*, Tiles at a Lower Level which Carry Away the Filtered and Purified Effluent. To accomplish this, the sewage should be discharged, preferably about once in twenty-four hours, either by an automatic arrangement or by hand. Fig. 48.

Under especially favorable conditions or with a large amount of sub-surface tile, this intermittent discharge is not absolutely necessary, for the sewage naturally comes from the house more or less intermittently. In a large country house or institution a more elaborate system of filtration is necessary. Fig. 50.

As the sewage coming from the house is warm, such a system as described will continue in effective operation during the winter time. Rain water from the roof or surface should not be led into the septic tank, as this would dilute the sewage to such an extent that the action of the bacteria would be incomplete.

WATER-CARRIAGE SYSTEMS

The
Public
Sewer

In large places where there is a generous water supply and a public sewer, both human excreta and all waste water are carried into it through pipes by means of water, while the final disposal is a matter of municipal sanitation. This is a water-carriage system of drainage. It could and would be used in many more places were the dangers of sewage-soaked earth understood and the importance of sanitary conditions appreciated. Properly installed, used and cared for, it is no doubt the best method of removal of these highly dangerous wastes. But the average housewife knows less about such a system than she knows about wireless telegraphy. She knows the starting point and she may know the destination, but how the two are connected she may never have thought. Yet Col. Waring said, "The drainage system is a trustworthy ally only so long as the *woman* of the house holds it under *close* and *careful supervision*."

Drainage
Systems

A water-carriage system of drainage comprises first, fixtures for receiving the solid and liquid wastes. These are sink, tub, basin, bath, closet, etc. These are the open, expanded mouths of certain pipes which are seldom seen throughout their whole length.

If all is right, when any dirty water is emptied the housewife never sees it again. Where does it go, and how? Fig. 51 will help us to follow its travels.

Fixtures

Take any *fixture* as a basin *a*. The plug being removed from the pipe, the water runs out of sight. It

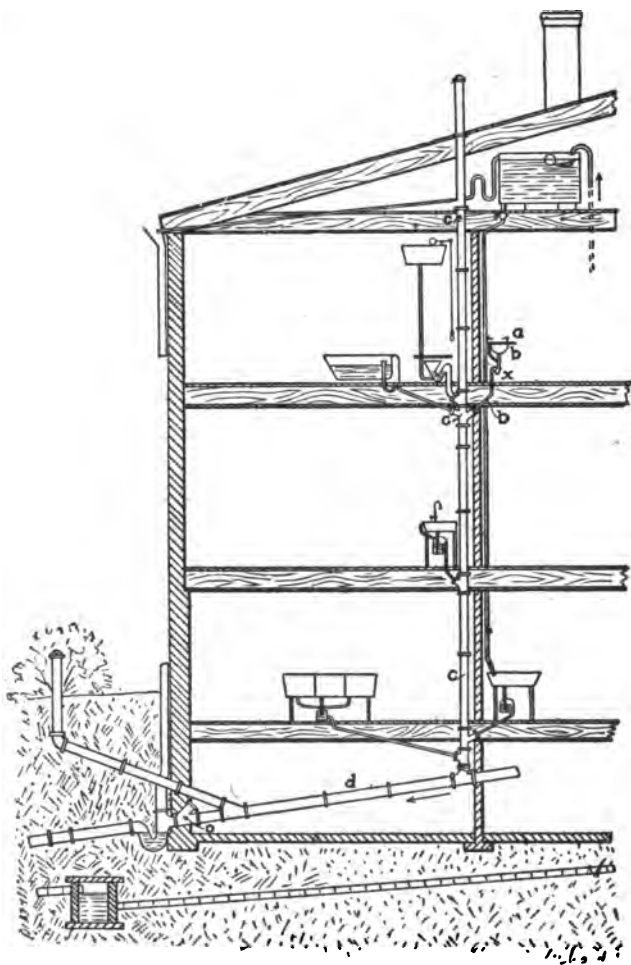


FIG. 51. HOUSE DRAINAGE SYSTEM.
a, Fixture; b, Waste Pipe; c, Soil Pipe; d, House Drain; o, Clean-out;
x, Trap.
 (After Gerhard.)

passes through the *waste pipe b* into the *soil pipe c*. Down this it rushes into the *house* or *main drain d* and empties from it outside of the house into a larger pipe which connects with a still larger one hidden under the street or elsewhere, which we call the sewer.

Traps

At *x* is seen a bend in the pipe and this bend is filled with the last water which went down. This is a trap. Other traps, that we know, are intended to catch things which are disagreeable and dangerous, and a good trap always holds what it catches.

These pipes all carry decomposable matter and the final results of decomposition are gases. In this case we group them all as sewer gases because each pipe is a miniature sewer.

Not only is there ordinary decomposable matter held in the water but also discharges from throats, nostrils, sores, and human excreta likely to be infected with germs which are the actual causes of disease. The gases are disagreeable and odorous and may interfere with health, the germs are capable of causing disease, therefore there must be no possible chance that either shall pass backward from the sewer or the connecting pipes which open inside the house.

**Water
Seal**

The water in the bend seals that pipe from such possible return. It is called the water-seal. Any device which will retain a sufficient quantity of water to thus seal the pipe will be a trap. Fig. 52 shows different styles of traps acting in various ways but all intended to hold the last portion of water until the next use of

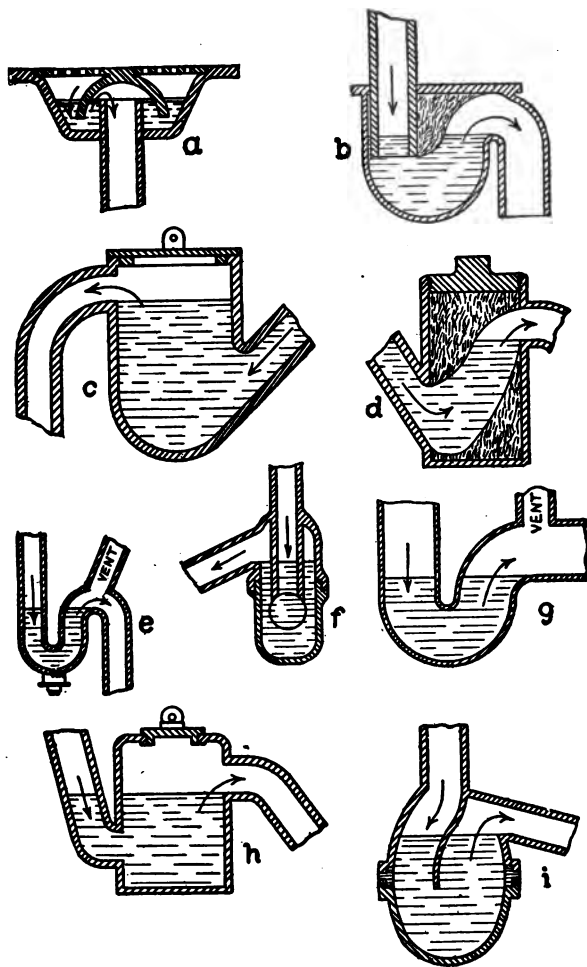


FIG. 52. STYLES OF TRAPS.

a, Sink Trap; *b*, Showing Accumulation of Filth; *c*, Pot Trap; *d*, Bottle Trap Showing how Grease, etc., may Accumulate; *e*, S Trap with Vent; *f*, Ball Trap (an old style); *g*, Half S Trap; *h*, Grease Trap; *i*, Non-siphonable Trap.

the fixture. Good plumbing requires that every pipe have its own trap near the fixture, that as little space as possible be unprotected. A set of two or three laundry tubs, however, is allowed one trap.

Waste Pipes

The waste pipe whose course we traced emptied into the soil pipe. This is the usual way with waste pipes above the first floor because this is the more direct and saves much extent of pipe. It might, however, run directly to the house drain. The soil pipe originally received only the contents of the closets and from this it obtained its name. Now, however, it may receive waste from any fixture.

Closets

The closet receives the solid and the most dangerous waste. It then should be most carefully placed and trapped. It should empty its contents promptly and completely and be thoroughly scoured and washed at every discharge. To insure this, it should empty directly into the main vertical soil pipe. Any closet which must be removed from this main pipe should have its connecting pipe of equal size and it should incline to the main pipe.

Soil Pipe

The soil pipe with all the branch pipes emptying into it make the stack. Fig. 51. Healthful conditions and economy both require as concentrated a system as possible to avoid cutting the house for numerous pipes, which increases the possible dangers and the cost of repairs.

**Sewerage
Sewage
Sewer**

The whole system of pipes is called the *sewerage* of a house, the contents of the sewerage is *sewage* and

the main receptacle which receives the sewage from any one or many sections is known as the *sewer*.

It is evident that the efficiency of such a system depends upon a generous water supply. It is also evident that there must be adequate and safe final disposal of the sewage. These are usually questions of public sanitation, but it often becomes the problem of the single country house, as has been shown, pp. 124-127.

As it is not safe and ought to be made a criminal offence to pour sewage into fresh water streams, the sea is the only water disposal left. This is available, of course, in certain sections and perhaps allowable if the discharge be in deep water with swift current, with no danger of tidal wash which would pollute the banks with decomposable matter.

Disposal
of Sewage

Public sewage is sometimes treated chemically.

Requirements for Safe Plumbing.

The sanitary requirements of safe house plumbing are four:

Prompt, rapid and complete removal of all waste;
No possible return of any waste whether gases, liquids or solids;

Cleanliness throughout the system;

No possible communication between the drainage and the water supply.

To insure these, there must be, according to Gerhard:

1. Soundness of material,
2. Perfection in workmanship,

3. Simplicity in arrangement,
4. Accessibility,
5. Safe trapping,
6. Thorough ventilation,
7. Efficient flushing,
8. Absence of complicated mechanism,
9. Noiselessness,
10. Prevention of water waste and protection against freezing,
11. Durability, efficiency, convenience,
12. Cleanliness and purity.

Most of these refer to the installation of the system which, in the new house, requires skilled, honest workmen and on the part of the owner a willingness to pay for what health requires. It is wiser to pay for these requirements than for the sickness which may follow their neglect.

**Use and
Care**

Even this ideal system would not remain sanitary without proper use and care. For this the housewife is responsible. Only matter quickly soluble in water should be allowed to pass into the pipes. This bars out the wisps of hair, matches, "sweepings," apple skins, peach stones and even larger objects which are often found in such places.

After the dirty water has passed enough clean water should be run into the fixture to fill the trap, that is, *leave clean water in the trap!*

**Greasy
and
Soapy
Deposits**

Care must be given to keep the pipes and traps free from congealed grease, soapy deposits and organic

slime. These can be prevented by a generous use of hot water and washing soda or potash. Not only is there danger of stoppage from the hardened grease, but the flow will be interfered with and in winter in exposed situations a frozen and burst pipe is likely to result. Many a neglected sink pipe becomes so lined with greasy slime that only a thread of water can trickle through. Laundry pipe traps are liable to be stopped by collections of the inevitable lint, soap with pins, and buttons, etc., which ought to have been removed or fastened previous to washing.

Every trap should be furnished with a cleanout through which any sediment may be removed. This should be under the water-seal. It is then effectually sealed itself and any leakage will be visible.

**Cleanout
of Traps**

With the grease trap sometimes used in the kitchen, the cleanout is seldom at the bottom because the grease being lighter than water can be easiest removed from the top. In the private house it is possible to prevent large amounts of grease from going into the drainage pipes and the grease trap may well be dispensed with.

**Grease
Traps**

One part where decomposition often makes itself known by putrid odors is the overflow pipe in basin or bath, as shown at *o* in Fig. 53.

In old style basins this overflow pipe connects the perforated opening with the main waste. It receives dirty, soapy water when the bowl is full, but only a little. It is never fully flushed except when the bowl overflows and even then there is little scouring action.

**Overflow
Pipes**

No wonder that putrid odors come from such a pipe!

In other styles the overflow channel is a part of the basin itself and opens at the beginning of the waste.

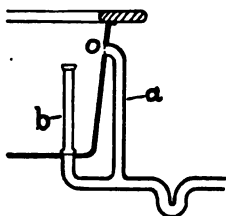


Fig. 53. Overflow Pipes. *a*, Old Style; *b*, Stand Pipe.

This makes a shorter space for filth collection, but there is no thorough washing of the pipe. Hot water, or better, hot washing soda, should be forced through the perforations. It can be done with a syringe or spring-bottom oil can, or thrown forcibly against the holes.

There are now many better styles, of which the straight stand-pipe is as simple as any.

Fig. 53, *b*. This at least can be scrubbed with cloth and brush. No overflow is sanitary that cannot be thoroughly and frequently cleaned.

Many times the plumber is called in to find a supposed defective pipe when all the trouble comes from this unclean overflow.

Open Plumbing

Every housewife should know where the traps are and where the pipes run. Where pipes are hidden in walls, nails and screws often puncture them or rats gnaw them to get at the organic matter within. All traps and joints should be easily accessible. This is the advantage of open plumbing and the pipes may be finished so that they are pleasing to the sight. When any pipe must run under the floor or behind any wood-work, the boards over it should be fastened with screws

instead of nails, or they may be hinged like a door, then they can be removed with no damage to the house.

The boxing-in of the soil pipe, even with the hinged door, although it seems unobjectionable, often turns out to be troublesome from the inclosed and therefore impure air there present. It is much better to have all such pipes exposed; when well finished they are certainly no more unsightly than heating pipes or radiators.

Every city or town makes some law governing the inspection of new plumbing. In the smoke test, touch-paper, wool-waste or other substance is burned and the dense smoke forced through the system. Any opening in pipe, joint, trap, etc., will be exposed and located by the presence or smell of the smoke.

**Plumbing
Tests**

Other tests are the pneumatic and water tests. All of these must be applied by the expert. These are used also to test the condition of old sewerage, but there is another which the housewife should understand and may apply. This is the peppermint test. Its value depends upon the extremely penetrating odor of the oil of peppermint. It will not accurately locate the defective spot, but does show that something is wrong. The plumber should then be sent for. Two persons are necessary to apply the test properly. One or sometimes two two-ounce vials of the oil of peppermint sold by druggists are necessary and only one of the persons should handle this. If the top of the soil pipe

**Peppermint
Test**

is accessible from the roof, the peppermint should be poured in there and followed by four to six quarts of hot water to increase vaporization and the passage of the oil. A board should be laid over the top. If the pipe is not accessible use the highest fixture and insert the plug and close the overflow.

The door should be closed, the vial emptied as soon as the cork is removed and the one who handles the vials should remain where she applied the oil while her assistant waits in the cellar until she hears the water coming down. She will then go through the house inspecting every fixture, following the course of every pipe, noting carefully any odor of peppermint. If the system is intact no odor should be perceptible. It will be intercepted by the water-seal.

If the vent pipe of the system, described later on, extends above the roof this should be closed before the oil is poured into the soil pipe.

**The
House-Drain**

The house-drain receives all the sewage of the house and must be large, strong, and so placed as to most speedily and completely carry this outside of the house. It is usually of iron, five or six inches in diameter, according to the amount of sewage it will be required to carry. If too small it may be stopped, if too large its sides will not be sufficiently flushed. It should slant at least one-half inch in a hundred and be kept in sight in order that any leak may be known at once. It may be hung from the ceiling or carried along the foundation wall or floor, or raised on piers. If fixtures like servant's closet, laundry tubs, etc., are located on

the cellar level, it may be necessary to sink the drain in a trench below the level of the cellar floor. In no case should it be left inaccessible.

The soil pipe is generally made of cast iron in sections of four or five inches diameter, smoothly finished inside. It should extend full size straight through the house and usually to a distance of two feet above the roof. Its top must be open to the air and covered by nothing more than a wire basket to keep out birds and leaves. It should end at least two feet from the nearest chimney top and not open near a window or ventilating shaft, otherwise impure air from it may possibly enter the house.

**The
Soil-Pipe**

The waste pipes are either of iron or lead. The size varies with the single fixtures that are supplied from 1 1/4 to 2 inches diameter.

Materials

All fixtures should be of impervious material or made so by the processes of manufacture. The best are in one piece with curved angles and rounding edges to prevent as far as possible the lodgment of dirt and to facilitate perfect cleaning.

Around plumbing, wood should be used as sparingly as possible for it is highly absorbent and the best finish will succumb to constant attacks of water. When wood is used it should be frequently oiled or painted.

No more convenient and useful fixture is found than the water-closet. Because it receives the most dangerous wastes, it should be thoroughly fitted to its pur-

**Water
Closets**

pose—simple, strong; of non-absorbent, smooth material; of a shape exposing the least amount of surface to the excreta. The excreta should be received into

water directly, that deodorizing may begin and fouling of the sides of the bowl be prevented.

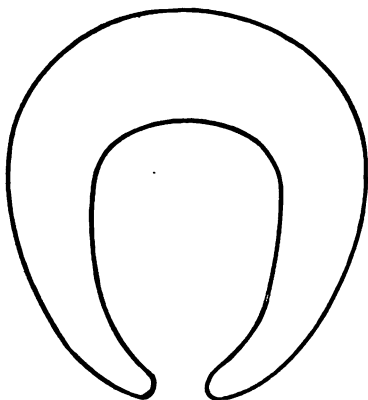


Fig. 54. Sanitary Seat.

The entire bowl should be thoroughly washed at every flush and given a daily cleaning. If not of good shape, properly placed and connected, properly used, watched and cleaned, it becomes the indirect source

of foul odors and possibly of disease.

It is better to have no wood about it, but if the seat be desired, let it be like Fig. 54, and omit the cover. Both seat and cover are subject to the spattering of soiled water, which may dry and give harmful dust. When the finish is gone the absorbent wood is exposed and is then kept dry and free from odors with great difficulty. Where there is a cover it should not be closed or at least not until the water flows gently without spattering.

The best earthenware closets have a large trap cavity in one piece with the receiving bowl, Fig. 55. This has a rolled rim, perforated underneath to receive the water and to discharge it in numerous small streams over the entire surface.

**Earthenware
Closets**

The contents of the trap should be speedily and entirely changed at every flush. This requires a sudden and copious rush of water not a small, slow stream. From three to four gallons is none too much to scour

Flushing

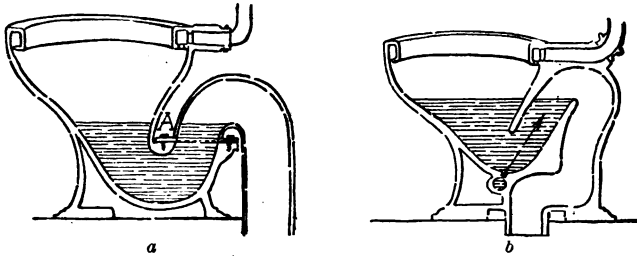


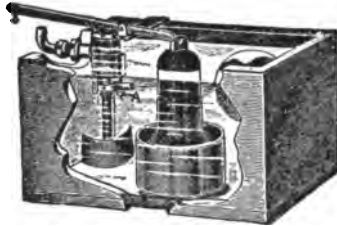
FIG 55 EARTHENWARE WATER CLOSETS.
a, "Washdown" Closet, b, Siphon-jet Closet.

the surface, drive the contents out of the trap into the soil pipe, remove them beyond the house and allow enough clean water to be retained for the seal.

This flushing water should always be drawn from a special tank, not from the main water-supply pipe nor from the house tank. The flush tank is usually placed above the closet near the ceiling and is operated by pulling down a chain. It may be attached to the closet and operated by a lever or in very cold places it is

sometimes sunken below frost line, when the water must be raised by mechanical means.

**Flushing
Tanks**



**Fig. 56. Automatic Emptying
Flushing Tank.**

The flushing tank, Fig. 56, is a box usually of wood lined with zinc or copper, placed inside a box finished as desired. It should be covered to keep out dust but be accessible for repair or cleaning.

A pipe connects the tank with the water supply and another

with the closet rim. These are operated by different devices which open and shut valves. The supply valve is usually operated by a ball cock. A light, hollow ball floats on the surface of the water. As the tank is emptied, the ball sinks and automatically opens the supply pipe; when the tank is full the valve closes.

**Self
Emptying
Tanks**

A chain is attached to a lever which operates a plug closing the flushing pipe. When the chain is pulled the lever raises the plug which remains up until the tank is nearly empty, when it is closed by suction. In some old style tanks the valve remains open only so long as the chain is held down. To thoroughly flush a closet served with such a tank, the chain should be held until the tank is emptied. Fig. 57 shows the ordinary style of tank, *a*, and the low down tank, *b*.

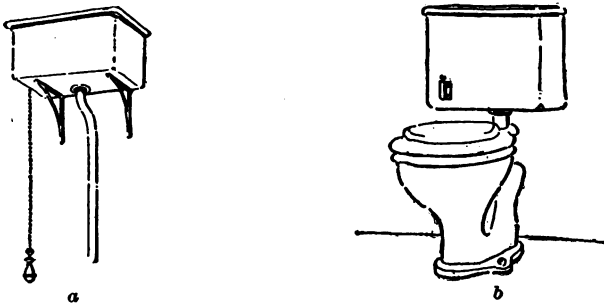


FIG. 57. FLUSHING TANKS.
a, Ordinary Style; b, Low Down Style.

Automatic arrangements are arranged for public places where persons may not be trusted to attend to the flush.

Automatic Arrangements

In the "old pan closet," Fig. 58, the flush was too weak to furnish sufficient scouring action, the pan grew rough and held the filth, and the lower receptacle could never be cleaned by hand. It is never allowed now in new houses and should be removed where present.

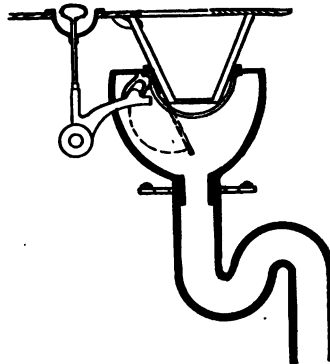


Fig. 58. Old Style Pan Closet.

The hopper closets, Fig. 59, a the short hopper, and

Types of Closets

b, the long hopper, were common a few years ago but not much used at present. The joint *x* between the hopper and the iron trap may become imperfect and allow leakage. The receiving water is too low and the long hopper has too great a space liable to be fouled and difficult to keep clean.

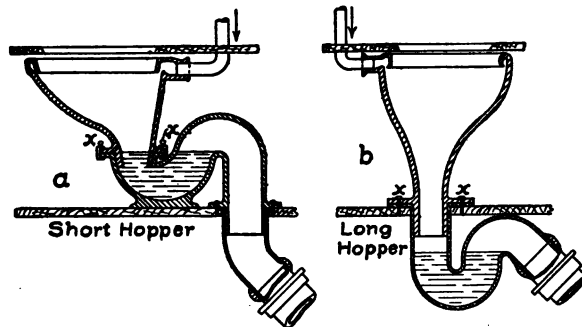


Fig. 59. Old Style Hopper Closets Showing Inclined Connection to Soil Pipe.

**Wash-Out
Closet**

The wash-out closet, Fig. 60, was formerly in considerable favor and is still much used. The passage at the back is difficult to clean and part of it is so nearly out of sight that foul conditions are not recognized. The large surface often becomes discolored, even when clean, and looks unsightly.

**Wash-Down
Closet**

The style known as the "wash-down" closet is much to be preferred. Fig. 55, *a*.

The various forms of syphon closets are perhaps the best in use. In these a large volume of water stands at a high level preventing the sides of the bowl from becoming soiled.

**Syphon
Closets**

In one kind, Fig. 55, *b*, there is a jet at the bottom through which part of the flushing water is forced. This throws over into the longer arm enough water to start the syphon, which, once started, carries the contents of the bowl through the trap into the soil pipe.

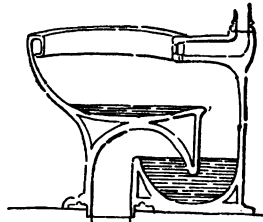


Fig. 60. Wash-out Closet.

Any pipes carrying organic wastes not only need to be thoroughly flushed with water for the dilution of the contents but also with fresh air for their oxidation.

The soil pipe opening at the roof serves as an exit for the gases—products of decomposition—within the system. This decomposition will not be carried on perfectly unless fresh air be admitted at the bottom.

**Ventilation
of the
System**

In some cases there is a main trap in the house drain just inside the wall which acts as a seal against any pollution from the sewer. If it is there, it must have an easily accessible cleanout for it is very apt to become choked. Some authorities would dispense with this trap entirely, thereby eliminating the chance of stoppage, and making the street sewer the lower opening

for the ventilation through all the connecting soil pipes. The healthfulness of this latter method depends chiefly upon the kind of sewer and the purity of the air in it. In some way there must be a thorough ventilation of the house-drain and soil pipes with as little interference as possible.

Main Trap The main trap is sometimes put as in Fig. 61, with a fresh air inlet from the house side. In this way the system is sealed from the sewer air and with the two holes—inlet and outlet—necessary for ventilation.

The air inlet at the foot of the system should open a little removed from any door or window and be protected from obstruction. It is often hidden in shrubbery. Fig. 51.

Siphonage The water-seal of some traps is liable to be broken under certain conditions. When a large quantity of water from an upper fixture is discharged into the soil pipe, or rushes by from another fixture on the same line of waste-pipe, it pushes the air ahead of it like a piston.

The pressure on the sewer side of the water-seal being thus removed, the air pressing on the fixture or house side of the same seal drives the water over, either partially or entirely, leaving the trap unsealed. This is called siphonage. Fig. 62.

To prevent this accident, air is admitted to the sewer side of the trap in order that a partial vacuum may not be formed. Fig. 63. To be effective the vent should be

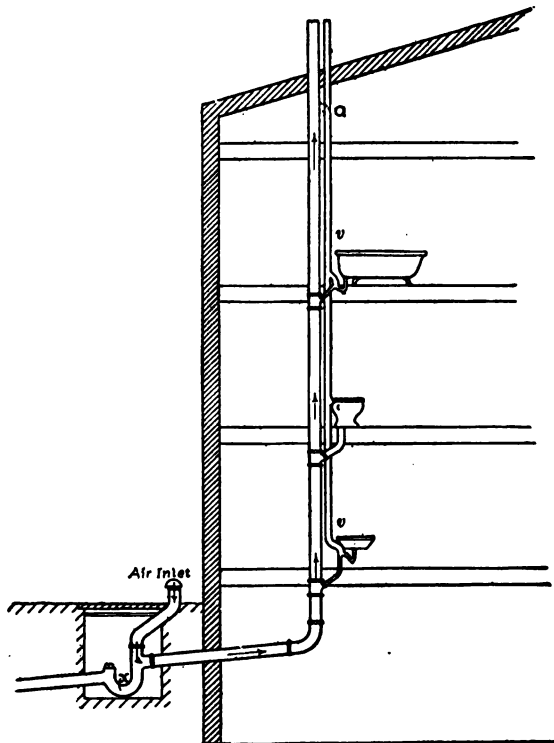


FIG. 61. DRAINAGE SYSTEM SHOWING VENTILATION THROUGH THE SOIL PIPE AND "VENTS" *v* TO PREVENT SIPHONAGE OF TRAPS

The vent pipe may join the soil pipe near the roof, as at *a*.

Air Vents of the same size as the waste pipe with which it connects. These are better called "back air" pipes.

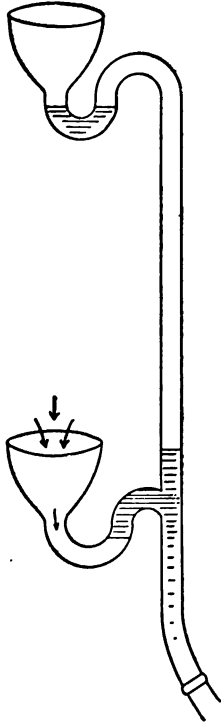


Fig. 62. Showing How a Trap May be Emptied by "Siphonage."

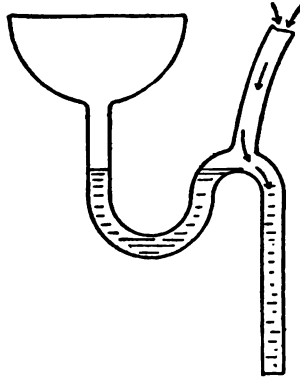


Fig. 63. Air Coming in Through the "Vent" Prevents Siphonage.

Certain types of traps will not siphon out, and with these the branch vents may be omitted. It is found that these vent pipes often collect and retain filth at their point of connection, Fig. 64, and thereby fail to fulfill their purpose. There is a difference of opinion among sanitary engineers as to the advantage of one system over the other for general usage.

In many cities the vent system

is required by law. The pot or bottle traps are not liable to siphonage, but being so large they collect a considerable amount of foul matter. Too often the necessary frequent cleaning is neglected and this filth is retained, so that in time only a small stream can flow through, Fig. 52, *d*.

Sometimes pieces of lint and string accumulate and by capillary attraction slowly empty the trap and destroy the water seal. Fig. 65. Again, if the pipes are not used for a considerable time, as when a house stands empty, the water in the trap may evaporate, leaving free access to sewer gases with their attending dangers. If the house is left closed for a number of months, care should be taken that stoppers for all bowls, bath tubs, etc., are in place; two or three layers of paper should be pasted over the overflow openings, and the trap of the water-closet emptied and stuffed with paper. This last is especially needful if the time be winter, for the water is sure to freeze and by expanding crack the trap. A little oil poured down each trap will retard evaporation to a considerable extent.

The small vent or air pipes join the main air shaft which runs from the base of the system either through

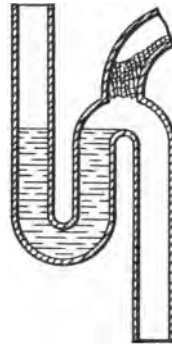


Fig. 64. The Vent May Become Stopped Up.

Care of
Traps in
an Empty
House

the roof or into the soil pipe above the highest fixture. Fig. 61. The air pipes of the plumbing system do *not* ventilate the fixtures or the rooms.

**Local
Ventilation**

Ideally, the bowl of the closet should not ventilate into the room but through a pipe into a special flue.

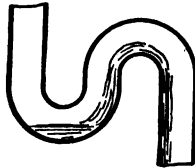


Fig. 65. Lint and String
Emptying a Trap.

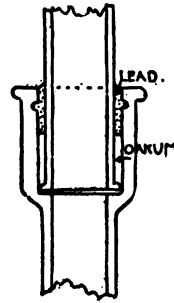


Fig. 66. A Good Pipe
Joint.

Very few houses are arranged for this, although all modern closets have an opening at the back of the rim for attaching a ventilating pipe. Such a pipe may be led into the chimney flue and will then be effective if the chimney is in use. When the ventilating pipe is small $1\frac{1}{2}$ or 2 inches—it will not interfere seriously with the draft.

Joints

Unsafe plumbing is perhaps due more than to any other one thing to imperfectly made joints. Joints should be few in number and each absolutely gas and water tight. Fig. 66. Because of possible obstruction,

no right-angle bend or joint is allowable. Angles are made by perfect or modified Y-joints. Fig. 61.

Some joints of putty or cement, rubber or lead washers are tight at first, but in time crumble and disintegrate. This may not be noticed and therefore the source of sewer air or filthy leakage be unsuspected. Honest and skillful plumbers, and none others should be employed, will make honest joints.

Even with the best of material and workmanship, the house sewerage system should be watched constantly and tested by the peppermint test every year or so.

This peppermint test, applied by the housewife with the help of an assistant, may save much expense from expert examination, as well as danger from delayed repairs.

**Constant
Oversight
Necessary**

FURNISHINGS

The house located on rising ground ; protected from dampness or bad air by thorough drainage and impervious cellar walls and floor ; with sunny exposure on all sides ; planned and built for health ; supplied with pure water ; efficiently heated, ventilated and lighted ; with proper provision for the removal of all wastes—this healthful house should be furnished healthfully.

Nature's Disinfectants

As we have seen, the furnishings should not interfere with a generous, daily supply of sunshine, fresh air and light. They should not be so numerous, complicated or delicate as to demand undue time and strength from the caretakers, for life is far more than living. Intellectual and spiritual duties are interdependent with the physical. Each suffers with the whole if one is over emphasized and no one has a right to wreck his own life or that of another.

With sunshine, light and air assured, it would be difficult to make an actually unhealthful house. But the number or character of the furnishings may make the dust problem so difficult of solution that the health of the family is threatened.

Sanitary Furnishings

Healthful furnishings are those which in material, construction and finish add no injurious particles to the air and allow frequent, thorough and easy cleaning. This must be done, also, without the sacrifice of their usefulness and beauty.

Few materials used in furnishing are in themselves unhealthful. In fabrics or wall paper there may be dyes which either in themselves are irritating or poisonous when in contact with the body, or become so during the chemical changes which sometimes go on in them after they are in use.

Arsenic is occasionally found in wall papers and in fabrics of many kinds, but because of stringent laws these dangers occur much less often than formerly.

**Arsenic
in Wall
Papers**

The construction of all articles should be simple, strong, and above all it should not interfere with easy, proper and frequent cleansing. Seams and corners in the kitchen utensils collect food wastes, and are difficult to keep clean and dry. They collect dust, become filled with food, then putrid, and thus fresh food is infected, and both health and the pocket-book may suffer.

Heavy, thick fabrics are left to store dust and odors because too difficult to remove. Fabrics of delicate texture and intricate ornamentation are left unclean because of possible injury in the cleansing processes. Light may be shut out lest expensive furnishings be faded. Costly articles are bought which need skilled care for their preservation and only unskilled hands are available. Unless there is knowledge and skill in the household staff or money in the household exchequer to pay for skilled labor, sanitation and economy both say "No" to the purchase of such articles.

Fabrics

Unless an article is of more value in the help or pleasure which it gives to daily life, than the space it

occupies of the time spent in caring for it, it should not be considered. When one article is sufficient for the needs of the family, there should not be two.

Large, heavy furniture is difficult to move. It may prevent the proper cleaning of walls, floors, or even of itself. Rough surfaces hold dust, are difficult to clean and, uncleaned, become unhealthful and unsightly.

**Dust
Catchers**

Carpets, heavy draperies, upholstered chairs "fringed to the floor" store dust, become saturated with bad air and encourage insect pests. It is seldom possible to take them into the open air often enough to keep them free from dust and odors. These things may seem unimportant when in one room, but with all the rooms combined, the house is less sanitary or time and strength are spent which would better be spent in other ways.

**Wall
Finish**

Wall paper is made of organic material, is put on with paste which is subject to decay. It is absorbent and liable to be destroyed by thorough cleaning. Hard finish in plain color or in fresco is non-absorbent, repels dust and may be frequently cleaned.

Floors

Hard wood floors, carefully laid and finished, do not absorb odors, store dust or harbor insects. Rugs can be cleaned and aired out of doors oftener than carpets.

Draperies

Few draperies, and these put up so as to be easily removed and cleaned, will prevent much devitalized air.

Removable cushions, of smooth fabrics, can be sub-

jected to fresh air and freed from dust where upholstered furniture would remain unaired, odorous and dusty.

All woodwork as well as metallic and mineral surfaces kept smooth and polished do not retain the dust, which when held by condensed, greasy vapors and moisture from the air will soon render them "clouded," tarnished or dingy.

**Polished
Surfaces**

If present ideas of beauty and supposed comfort or economy require a departure from the strictest ideal of sanitary furnishings, then more care and attention must be given to keep them healthful. But science is every day coming to the aid of the housewife and uniting the sanitary finishes and furnishings with artistic form, color and texture.

**Sanitary
and Artistic
Ideals**

Comfort and convenience in one family are entirely different from the same requirements in another and conditions alter the application of most rules.

If wall paper is preferred above hard finish, the housewife must be willing to expend the greater care upon it and have it often renewed.

**Unsanitary
Furnishings
Require
More Care**

If a carpet must be tacked down, then let her remember that it catches as much dust as the floor and adds to this from its fibrous material. If her polished floor requires a daily cleaning, does not her carpet need it more? If health requires that dust be wiped off the former may it not require that the latter be wiped in a similar manner? Looks alone should not govern here.

- If the housewife cannot give time each day for care-

ful dusting, then either have fewer articles or those of such form, size and finish that they may be dusted in the time available.

The
Housewife's
Duty

We may well extend, until it include the whole house, what Col. Waring said about the drainage plumbing. For the house-mother's duty is not done when a large sum has been paid to architect, builder and plumber. Her duty has only begun. She has under her control means of safety or agencies "of destruction according as she performs her duty or neglects it. She cannot safely delegate her responsibility to her servants. Her own eye must see that at no point has neglect at any time permitted even the beginning of filth, for the *beginning* of filth is the beginning of danger."

CARE AND CLEANING

The health guardian of the healthful house will first of all seek to prevent dark, damp places and the lodgment and storage of dust. Next comes the daily duty of keeping the whole clean. This cleanliness tends both to the health of the family and the preservation of food and furnishings. The daily dusted woodwork will not need to be cleaned so often and when cleaned will not take so much time or strength. "One keep clean is worth a dozen make cleans."

Prevention

House care means attention to all parts of the house and its exterior surroundings that any defect may be quickly remedied. It means a daily sunbath in the interior, flushing the whole house with fresh air, strict watch over the lighting and the drainage plumbing or other system of waste disposal. It means that the household be comfortably warm or cool, according to the season or the bodily condition of each individual. It will probably require a daily inspection of food storage places—refrigerator, cold storage, and possibly the cellar.

**Present Day
Housekeeping**

This inspection must extend to all food supplies as they come into the house—their proper cleaning, preparation and cooking; to the utensils which hold the food, and the prompt disposal of its wastes while yet fresh.

**Careful
Inspection**

It means clean dishes, which are impossible without sweet dishcloths and driers and cupboards untainted by insects attracted by moisture and odors. It means

clean beds—frames and springs—as well as bureaus and tables wiped free from dust; dust removed from floor or carpet more than from the mantel. It means attention to soiled clothing while it waits for the laundress. In short, house cleaning is the daily removal of unpreventable dust and other soil by methods as speedy and easy as ingenuity can invent or money command.

**Healthful
Houses**

While a *clean* house may be disorderly or ugly—a place to avoid rather than to seek, a *healthful* house will be orderly not stiff, bright not gaudy, cheerful, usable and clean—the place of all places best for the efficient development of every civilized human being.

Dusting

Having studied the matter of house finish and furnishings from the standpoints of health and beauty the wise housewife will consider safe, speedy and effectual methods for dust removal. In sweeping she will discard any implement or method which simply changes the place of the dust by throwing it into the air to settle again when the room is quiet. She will *burn* collections of fluff and dust called “sweepings.” She will allow time to elapse between any dust-spreading process and her attempt at its removal or dusting. She will always try to wipe up dust rather than to brush it away. She will make the acquaintance of the sanitary, damp or oiled dust-cloth and wash it after use; she will see that any cleaned surface is left dry to prevent the lodgment of dust which makes her previous work of little avail. With such a sanitary engineer the principles and practice of housework will

draw upon all the chemical, physical and bacteriological science she can command.

PESTS

The healthful house will be free from flies and mosquitoes. Flies carry on their feet and probosis the disease germs gathered from moist sputa, exposed feces, from pus and other infected discharges. These are easily deposited upon any surface over which they crawl as upon food and the moist membranes of the body.

**House
Flies**

Now that we may surely blame one genus of mosquito for malarial infection, every housewife should be absolutely inhospitable to all for at any time the enemy may appear among them.

Mosquitoes

Dr. Rosenau has said: "When the matter is generally understood, it will be a greater reproach to the housewife to have mosquitoes and flies in the house than bedbugs."

Although early and complete screening of doors and windows may practically insure freedom from both these pests, it should be remembered that it is easier to keep out a dozen than thousands. The only way to prevent swarms of either is to prevent their reproduction and to remove attractive food. For flies this requires especial attention to horse droppings in stables and streets, human excreta in privies, and the covering of food which will draw them by its odor. Indeed, the sense of smell is so keen in flies that they will make their way through unused chimney flues. It is wise to screen such openings.

**Breeding
Place of
House Flies**

If all liquids and food substances are carefully covered they will not at least be infected with eggs or disease germs.

Mosquitoes lay their eggs on the surface of still water, therefore the uncovered rain-water barrel or tub of wash water; the roadside puddles, or water collected in old tin cans and broken dishes; a neglected farmyard trough or privy vault may furnish this pest for an entire season.

**Killing
Mosquitoes**

Fortunately we have an easy and efficient method of killing mosquitoes. They are killed by the sulphur dioxide which is formed by burning dry sulphur. This will not bleach fabrics, not tarnish metals, so long as they are dry; but it is so difficult to have everything dry that metals and fabrics would better be removed from the room in which the sulphur is burned. Mirrors also are liable to be injured. This extreme method would not be necessary perhaps unless the malarial variety were known to be present.

**Pyrethrum
Powder**

The ordinary pyrethrum powder when burned will stupefy them and they should then be swept up and thrown into the fire. They are very quick to hide themselves and must be hunted out. In yellow fever regions this method should not be depended upon for the escape of one may mean an epidemic.

Perhaps cockroaches and fleas, ants, and the cosmopolitan bedbug may be less often brought before the sanitary judge; but they are disagreeable, wasteful to food supplies and show the presence of wrong condi-

tions. With everything dry, light and clean, the cockroach army, if unfed, will soon move on.

As a germ bearer science is not yet ready to say, "Not guilty!" to the bedbug. No preventive methods can insure complete freedom to any house from such a common foe, but constant watchfulness and prompt action when the stray one is brought in will prevent its reproduction into a pest.

Pests

DISINFECTION

Even in the healthful house prevention and removal may fail to keep out all germs, then disinfection is essential. Disinfection should mean death to all disease germs but in any one case no one can tell that this has been done. The process must be so thorough that no chance of life remains. Some germs are much more resistant than others. The non-spore varieties may succumb easily while the spores resist even extreme methods, unless long continued.

Dry Heat

Materials which will be uninjured by dry heat should be baked for one hour in an oven heated sufficiently to quickly brown white cotton. A boiling temperature for half an hour will destroy all the known infectious disease germs—even the resisting spores.

Steam

Steam penetrates better. It kills both bacteria and spores. It is well to continue it for one hour or longer although less time may be effective with many germs.

Superheated steam in closed vessels is used in quarantine and public disinfecting stations.

Burning

Any infected material which is of little value should be burned immediately. No moist infected matter should be allowed to become dry before disinfection. Soiled fabrics or cloth which cannot be burned should be placed in some disinfecting solution until washed and boiled. All discharges should be disinfected before being carried out of the house. The volume of disinfecting liquid should be at least twice that of the discharge. Either the carbolic or corrosive sublimate solution may be used. When disinfected discharges

are put into a water closet at least one pint of carbolic acid solution should be poured around the vase and left in the trap after each use.

Liquid disinfectants must be used in strong solutions, usually in generous quantity, and allowed to act for an hour or more. One of the most effective of these is a five per cent solution of carbolic acid. Six ounces of the pure crystal to one gallon of hot water gives nearly this strength. Another is corrosive sublimate or bichloride of mercury, which must not be kept in metal vessels. For this 60 grains of the crystals are dissolved with two tablespoons of common salt in one gallon of hot water. These two solutions are very poisonous when taken internally. They do not usually affect the skin, although that of some persons is seriously irritated by corrosive sublimate.

**Carbolic
Acid and
Corrosive
Sublimate**

Milk of lime is often used where the white color is not an objection. This requires two pounds of dry, freshly slaked lime to four or five quarts of water.

Lime

Dry chloride of lime is also effectual in disinfecting moist matter. This also should not be kept in metal vessels.

**Chloride
of Lime**

These same compounds in weaker solutions while they may kill some varieties of germs retard the growth of all. They are then called Antiseptic. An antiseptic for spore-forming germs may be a disinfectant for the non-spore varieties. There are numerous antiseptics which may prevent an attack from germs, but they must not be depended upon when the disease germ is known to be present.

Antiseptics

Deodorants

A third class of substances associated with these in connection with germs is the *deodorants*. These do not kill the germs nor effectually retard their growth. They either remove odors by forming new non-odorous compounds by chemical action with the odorous substance, or they form new odors which being stronger cover up the original. The deodorant may or may not have a strong odor itself. Charcoal is a strong inodorous deodorant, while burning coffee is an odorous deodorant. In general deodorants are of little use.

**Gaseous
Disinfectants**

The gaseous disinfectants are valuable according as they penetrate more or less readily. Sulphur dioxide is the one most commonly used, but formaldehyde, although a little more expensive at first, is to be preferred. This is used in generators sold for the purpose. So far as is known it injures no furnishings and kills all germs. For mosquitoes, however, it is less efficient than the sulphur gas.

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Sanitary Condition of City and Country Dwelling Houses (\$0.50), G. E. Waring, 1898.
Sanitary Drainage of Houses and Towns (\$2.00), G. E. Waring, 1876.
Sanitary Engineering of Buildings (\$5.00), W. P. Gerhard, 1899.
The Care of a House (\$1.50), T. M. Clark, 1903.
The Disposal of Household Wastes (\$0.50), W. P. Gerhard, 1890.
The Farmstead (\$1.25), I. P. Roberts.
The House that Jill Built (\$1.00), E. C. Gardner, 1896.
The Human Mechanism (\$2.00), Hough and Sedgwick, 1906.

- The Soil in Relation to Health (Out of print), Miers & Crosskey, 1893.
 Ventilation and Heating (\$6.00), J. S. Billings, 1893.
 Water and Ice (\$0.75), T. M. Prudden.
 Sanitation of a Country House (\$1.00), Bashore, 1906.
 Sanitary Science (\$3.00) Sedgwick.
 The Healthful Farm House (\$0.60) Helen Dodd.

U. S. GOVERNMENT BULLETINS

Free of the Department of Agriculture, Washington, D. C. In ordering, give title and number.

- Sewage Disposal on the Farm and the Protection of Drinking Water. Farmers' Bulletin No. 43.
 Some Insects Injurious to Stored Grain. Farmers' Bulletin No. 45.
 Irrigation in Field and Garden. Farmers' Bulletin No. 138.
 Insecticides and Fungicides: Chemical Composition and Effectiveness of Certain Preparations. Farmers' Bulletin No. 146.
 How Insects Affect Health in Rural Districts. Farmers' Bulletin No. 155.
 How to Build Small Irrigation Ditches. Farmers' Bulletin No. 158.
 Drainage of Farm Lands. Farmers' Bulletin No. 187.
 The Country Slaughterhouse as a Factor in the Spread of Disease. Circular No. 62.
 Danger of Importing Insect Pests. Reprint No. 101.
 Insects as Carriers and Spreaders of Disease. Circular No. 235.
 Pasteurization and Sterilization of Milk. Reprint from Year-book 1894.
 The Contamination of Public Water Supplies by Algae. Reprint from Year Book of 1902.
 Invisible Micro-organisms. Circular No. 57, Bureau of Animal Industry.
 Care of Food in the Home, by Mary Hinman Able. Farmers' Bulletin No. 375.
 Modern Conveniences for the Farm Home. Farmers' Bulletin No. 270.

Circulars of the Division of Entomology

- The Carpet Beetle or "Buffalo" Moth. Circular No. 5.
- Mosquitoes and Flies. Circular No. 13.
- House Ants. Circular No. 34.
- House Flies. Circular No. 35.
- The True Clothes Moth. Circular No. 36.
- How to Distinguish the Different Mosquitoes of America. Circular No. 40.
- Hydrocyanic Acid Gas Against Household Insects. Circular No. 46.
- The Bedbug. Circular No. 47.
- The House Centipede. Circular No. 48.
- The Silver Fish. Circular No. 49.
- The White Ant. Circular No. 50.
- Cockroaches. Circular No. 51.

There are also many publications available from State Agricultural Experiment Stations and State Boards of Health.

Hygiene of Rural, Suburban and Summer Homes.
Bulletin of State Board of Health of Maine, Augusta,
Maine.

An Unhampered Cesspool, in Bulletin of New
Hampshire State Board of Health, Concord, N. H.

HOUSEHOLD HYGIENE

PART III

Read Carefully. Place your name and address on the first sheet of the test. Use a light grade of paper and write on one side of the sheet only. *Use your own words, and answer fully.* Read the lesson paper a number of times before attempting to answer the questions.

1. What are the solid and liquid wastes of a house and what unsanitary dangers from each of these classes?
2. What sanitary precautions should be taken with the following:
 - a feeding food wastes to animals,
 - b earth burial of organic wastes,
 - c removal of wastes by public teams,
 - d burning food and other wet wastes,
 - e disposal of ashes and other incombustible matter?
3. What dangers connected with the use of house slops for watering vegetable gardens; and where could such slops be safely used?
4. What objectionable conditions have you noticed in connection with the wastes disposal of your own or other house?
- 5a. What is meant by a sewage farm, surface and sub-surface disposal of sewage?
- b. What agencies are employed in all of the above and what are favorable conditions for their work?

HOUSEHOLD HYGIENE

6. Choose the part which applies to your own conditions:
 - a. What is an "earth closet"; have you ever had experience with one? If so, with what success?
 - b. What have you found the most difficult part of a water-carriage system to keep clean, and how have you accomplished it?
7. Describe the peppermint test. If possible, test the plumbing of the house in which you live by this means and report.
8. Mention at least three measures of prevention which you think important to consider in house furnishings.
9. What methods of dust removal have you tried and found effective?
10. Trace by a drawing or by words the course of the dishwater from the sink to the sewer in a water-carriage system.
11. What parts of a water-carriage system of sewage disposal should be watched most carefully?
12. Define and give the use of a *water-seal, trap, soil pipe, overflow pipe, cleanout, vent or back air pipes*.
13. What unhealthful conditions are there connected with the kitchen sink, the garbage pail, a water-closet bowl, the closet seat?
14. Why and how are mosquitoes and flies unsanitary?
15. What measures should be taken to prevent or remove these pests?

HOUSEHOLD HYGIENE

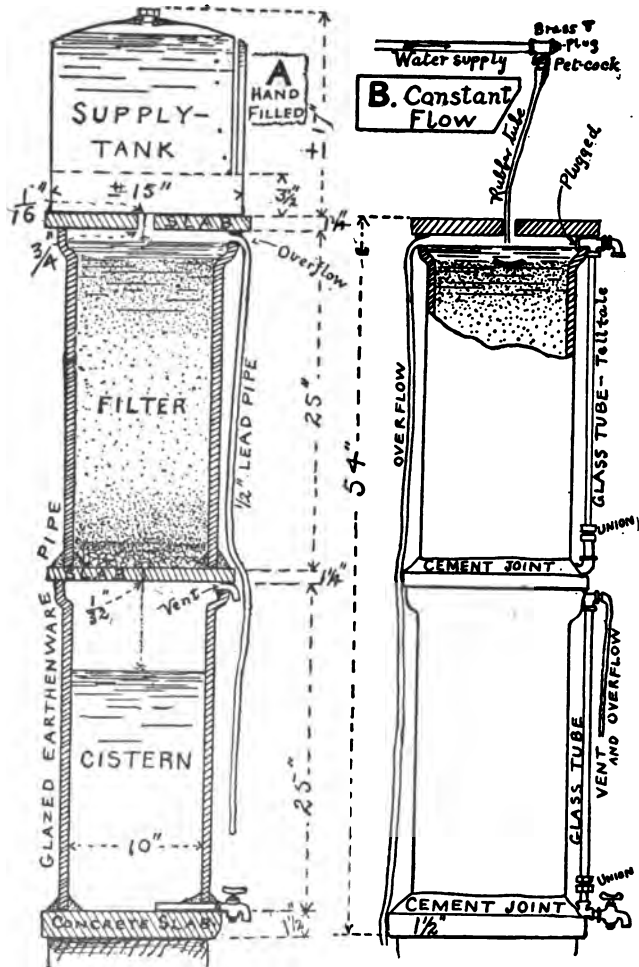
16. What is the difference between an *antiseptic*, a *disinfectant* and a *deodorant*? Mention some methods or substances illustrating each.
17. Outline the most important facts for a housewife to know concerning the house and its surroundings.
18. As a mother or teacher, what especial sanitary habits would you try to form with little children? Give these in detail.
19. Can you suggest any method of cleaning or house care which you have found especially helpful?
20. What do you consider the most valuable lesson you have learned from the study of *Household Hygiene*?
21. Are there any questions that you would like to ask in connection with these lessons?

Note:—After completing the test sign your full name.

Household Hygiene

Part IV Supplement

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SAND FILTER MADE FROM DRAIN PIPE

Estimated cost (A) \$10.50. (B) \$6.00 For description, see Bulletin of the New Hampshire State Board of Health, Concord (July, 1906)

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SUPPLEMENT TO HOUSEHOLD HYGIENE

CARE OF THE HOUSE

BY S. MARIA ELLIOTT, Simmons College, Boston.

It is so true, as before quoted from Colonel Waring, that "the beginning of filth is the beginning of danger," that it behooves the housewife to study especially the means of *preventing* or *removing* this beginning. But "Information precedes reformation," therefore information must be gained first. Some rhymester has told us that

"If only one would see
To his own reformation,
How very easy
You might reform a nation."

It is the individual house standing as an example of cleanness and order which silently reproves and preaches with effective emphasis.

As one of our students reports, "In two places where we have lived, when *we* cleaned up about our house our next neighbor followed our example." Each had never been known to do this before. Perhaps these neighbors did not know, before, the beauty of cleanness, the restfulness of order, the reflex moral influence of a clean body, in a clean house, among clean surroundings. Or, they may not have known how to attain the desired end. As soon as knowledge came, conversion followed.

No doubt most of us know good ways of cleaning out the dirty spots in our houses, if we had more time or strength to do it ourselves, or money with which to pay others for the service. However, as we have all met persons who did not know how, others who know better than we did in special cases, while some have asked for detailed methods for certain processes, it may not be wasted time to study over a few good methods of house care.

CARE OF CELLARS

We may not agree with Miss R. who says "Out of the cellar are the issues of life;" but we do know that if the cellar be not clean and dry and pure there will come the danger of death.

Few houses have a model cellar, therefore average conditions show how much more need there is for daily attention and frequent cleaning that the ideal be approached as nearly as possible.

Let there be daily inspection and ventilation. A few minutes observation will show whether there is any emergency which must be attended to and a little fresh air will prevent much harm.

Occasionally, usually as often as once a week, there should be a thorough cleaning. What this shall comprise will depend upon the style of cellar. We will take as a type an average city cellar with warm air furnace present, therefore not used for food storage.

1. Open windows, or door, on opposite sides if possible.

2. Pile up wood or put into the bin all loose pieces.
3. Put loose coal back into bin.
4. Put into refuse barrel, or burn, anything which is of no further use.
5. With an old brush or wet cloth over a broom or in the hand, as most convenient, wipe off the warm air pipes, sides and top of the furnace.
6. Brush off the ceiling, walls and all partitions, as round fuel bins.

Notice any evidences of dampness, as mold, rust; or of rat holes. Trace the former to their source that it may be remedied with the least expense. Fill up the latter with broken glass or crockery or with cotton wool well sprinkled with cayenne pepper. Then plaster them or tack on pieces of tin to improve the looks.

7. Sprinkle floor, or use dampened broom, sawdust or other dust-catchers and sweep thoroughly. Take up sweepings on dustpan covered with damp newspaper. Burn, or if there be many ashes, wrap them into the paper and put in the ash barrel. Let the dust settle at least while the servants' water closet is being cleaned.
8. Do whatever dusting is feasible and if necessary wash windows.
9. Let the room dry thoroughly before closing and lock both door and windows, unless able to leave the latter open.
10. Clean and replace the implements used.

This cellar water-closet should have most careful inspection and cleaning. Too often there is no ventilation except by the door into the cellar. It is apt to be dark and therefore neglected. The slant of the outlet pipe is many times so slight that stoppage is liable to occur, if special care be not taken to flush the bowl generously.

It is often wise to keep here some air disinfectant, as a saucer of moist chloride of lime.

Above all be sure that the hopper and seat are thoroughly cleaned and the latter kept well oiled. All woodwork must be well cleaned that no odors be absorbed.

Cellars not of this type should at least be kept dry and filled with fresh air, then otherwise cleaned in the ways most suitable.

Any fruit or other food storage places should be carefully inspected, that portions of food decayed may be removed. If this is not done, they will infect either the sound fruit, good food or the air of the cellar. Incipient decay may be easily removed and the larger portion of the food be unharmed. If not noticed until it has developed, much unnecessary waste results.

Once a year at least—twice is better—let all feasible portions be given a thin coat of whitewash. If the cellar is liable to be damp it may be wise to do this oftener, or to have small metal or earthen receptacles of unslaked lime constantly present. Renew the lime as soon as it is slaked.

CLEANING

The aims of the housewife are at least three. While she wishes first of all that her house be healthful, that is, that its condition tend toward the health of all its inmates, she desires as well that this shall be attended with the least legitimate expenditure of time, labor or money. This means, too, that the methods used must not injure the furnishings, so that they may, as long as possible, preserve their original beauty.

A little cleaning done often is far more economical than to let dirt accumulate. Accumulation necessitates hard rubbing, the use of much water, and often the use of alkalis, all of which may endanger the finish. When the original smoothness of surface is removed, more dirt is collected, held more firmly, therefore greater labor and expense are entailed.

Sanitation and economy are in fact twin sisters in more ways than we are apt to think.

This is the prime reason for polished surfaces whether in metal, mineral, or wood. The rough iron, marble or wood collects greasy moisture, dust settles into it, and soon grimy, discolored and unhealthy conditions exist. If the finish is preserved, the pores are filled, absorption is slight or none at all and dust may be easily removed.

Therefore all methods of cleaning polished or glazed surfaces should be chosen in their relation to the finish.

CLEANING WOODWORK

Wrong methods are often used with painted wood-work. Good paint consists of some solid substance mixed with oil and possibly varnish. The oil becomes changed under the influence of the oxygen of the air into a hard surface which fixes the solid material. Strong alkalies will combine with the oil softening the mass. Coarse friction will break the surface and thus in time roughen the whole mass. Paint, or other *finished wood*, should not be *scoured*, and alkalies must be used in weak solutions. A flannel or soft woolly surfaced cloth will give safe friction and not injure the surface. No more water should be used than will serve to soften the thin film. It should never be allowed to run or stand in drops.

As soon as the dirt is softened by soapsuds, weak ammonia, borax water or sometimes by oil, it should be washed off with the moist—not dripping wet—cloth. The surface should then be rinsed in clean water and rubbed dry with another cloth. Water if left to dry off by itself collects dust and then the finish will be clouded. Oil also does the same and instead of a bright, clean surface a sticky one results.

If the dirt is so fixed that these methods must be supplemented by more friction, a little whiting on the cloth will do safe scouring. Most of the mineral soaps are too coarse. Soap should be used in solution, not rubbed directly on the paint. In time this would certainly mar the paint. On well enamelled paint a flan-

nel cloth wrung out of hot water is usually sufficient for finger marks on doors, around knobs, etc.

By the way, the door knobs, too, may well have a daily dusting and frequent cleaning or scouring, according to material and finish.

If the "deadly door knob" be so important a factor in the spread of disease as to warrant a convention of doctors to meet in conference with railroad superintendents to discuss how this avenue of infection might be most wisely treated, the housewife may well give the little care necessary which her small and less dangerous conditions may require. It may save some sore hands, eyes, or even a serious illness in her children.

Unfinished wood, on the other hand, is unprotected, its pores are not filled and its fibres become raised by use. It then should be thoroughly scoured either with a stiff brush or coarse frictional material, or both.

Alkalies, water and oil all darken wood, therefore wood cannot be kept light colored when these are used in quantity.

The clean white floors of Colonial times had the surface constantly scoured off by the attrition of the sand which was thrown over them and often marked off into fanciful designs.

No unfinished wood will long remain clean or white if it be deluged with water, washed and rinsed—"Save the mark!"—and wiped up out of the *same water*. No wonder that we see so many streaked floors and dingy

tables in the kitchens. Streaked, dingy, clouded woodwork usually means either dirt, or water dried on. It is like a greasy or half dried dish. Good dishwashing ends in clear, shining dishes, but it means dirty water washed away and all water removed. This is best attained by the use of hot water wherever the material will allow of its use without breakage. Most materials will withstand a high heat, if it be slowly applied; while they would break under a sudden change either from cold to hot or vice versa.

Hot water evaporates so much quicker that the hot article dries almost immediately. Often in hotels, restaurants, and large houses all the cleaned dishes are packed in wire racks and plunged into boiling water. They dry instantly. They may not need any rubbing with a cloth; but if this is done there will be a higher polish. Contrast these in real cleanness and in looks with the unrinsed dishes "wiped" with half wet cloths which are so often seen.

CLEANING REGISTERS

"A little at a time and that done well
Is a good rule as many can tell."

This rhymed motto of our childhood seems to apply to the cleaning of registers and furnace pipes. In many houses this is never thought of. If the registers are in the floor they are often not covered while sweeping is done and the fluff collects in them in large quantities.

Many furnaces are not ashes tight in their joints and

the finest of powdery substances escapes into the air-chamber and is floated up into the rooms by the warm air currents.

The registers are seldom so tightly fitted that dust and ashes do not make their way up from the cellar in those upward currents of air which we have seen are constantly present in a house.

Then the entering air from the cold air box, unless it is strained, brings in much dust from out-of-doors. This fine powdery dust has been seen to flow into a room from a wall register, for ten feet or more.

It is possible for the lint and dried fluff to take fire in the pipes, if they become overheated. When there is no fire, this mass of dirt collects and holds dampness which rusts out the metal.

Registers should, then, be cleaned. If done often it need not be a difficult nor very dirty task.

Shut off heat from pipe. Lift up register, placing it where it cannot injure paint or other finish.

A wire screen should be under each register to prevent dirt from going into pipe. Remove this.

If there is much dirt in the box, push into the pipe a large piece of damp newspaper. It is well to keep hold of this else it sometimes sucks down beyond reach. Brush the dirt from the box into the paper and remove.

Clean the pipe as far as the arm can reach. Sometimes this will need only wiping with an oiled or damp cloth. This may be wound round a stick, a flexible

wire, a child's broom or a brush. Any feasible method which will accomplish the end may be taken.

Often there is a turn in the pipe which catches much fluff. This fluff should be removed. Sometimes a dipper or cup does it better than anything else.

Wipe all parts of the box with an oiled cloth. If this be done occasionally in summer it serves to prevent rust.

Place the register over a wet paper and clean out all the holes, especially round the wheel or slide which opens and closes the leaves. If a large tub be at hand the register may be more easily washed in this, with a brush. Then it should be dried and oiled before being replaced, or it may be replaced for drying and afterwards oiled.

Oil the leaves thoroughly. In damp weather these often rust badly and so become very rough. Rough surfaces anywhere, as we have learned, are dust-holders and difficult to clean.

Use a skewer under a cloth or any small stick to reach with the oil all parts of the lattice work. (By this time I am sure any woman will be ready to choose registers of simple pattern, if she can find them. If women demand them the manufacturers will make them. They make what sells best. Women being the chief buyers of household articles should set the standard of simplicity, not ornateness, especially in articles not readily cleaned.)

Replace the register after rubbing off all surplus oil.

Be sure that the wheel runs as it should. A drop of oil may be needed occasionally on the parts that bear against each other.

Wall registers often open into short horizontal lengths of pipe which get very rusty unless thus cleaned.

A suggestion here may be inserted for the benefit of some who cannot control the furnace and need more moisture in the air of their room. A small dish of water set in the register box will give off considerable imperceptible moisture. This may sometimes be done in a wall register. A wet sponge hung just back of such a register is another device, but one which requires more attention than a dish of water, if one can be used.

CLEANING RUGS

While rugs are much preferable to carpets, yet many large rugs are too heavy for a woman to lift and carry out of doors. They can be quite easily and effectively dusted by wiping with a damp cloth. Wipe a small portion along either length or width—usually it folds easier along the length. Fold this cleaned part over. Wipe the under side and the floor beneath. Continue thus until half is finished. Replace and repeat for the other half.

By the occasional use of carpet sweeper and frequent dampcloth dusting, many rugs need seldom be removed. Of course, they do not get the same air bath as when put out of doors, but if thus kept clean

from dust and the room be well aired, there is little danger of odors or of insect pests.

If insects are feared, a cloth wet in naphtha may be used if it be remembered always that no fire or light can be near and there must be thorough ventilation. The vapor of naphtha is given off constantly and is very explosive. The windows should remain open a long time.

THE CARE OF THE REFRIGERATOR

A refrigerator is a device for preserving food by the antiseptic method of low temperature. Too often the refrigerator itself is filthy and actually aids decomposition. While many of the bacteria are prevented from growing, others are not inhibited or even may be encouraged. Therefore any refrigerator should be scrupulously clean in every part. This means first that all liquids spilled should be wiped up at once, all crumbs removed. In summer there should be more frequent and thorough cleaning than in winter.

An experienced housewife may skip the following detailed directions; the inexperienced one may need them until she finds a better way. The cleaning of the ice compartment is of course best done when the ice is nearly out.

Let us hope that there is a pipe for the drip leading to a safe place!

Empty the water pan if it will have to catch any water used in cleaning. Remove all food, covering it from the dust.

Remove shelves. Scrub them with hot soapsuds, borax or ammonia water, using a brush. Rinse in hot water. Dry with a cloth, or put out of doors in a clean place, in sunshine if possible.

Scrub all parts of the food chamber in the same way, not forgetting the inside of the door, the ledges, etc., using a skewer under the cloth for angles and corners. Rinse in clean water and wipe dry. Leave it open to air.

Remove any ice, wrapping it in flannel or newspaper, to prevent waste.

Remove all racks. Scrub thoroughly as before. Scrub inside of ice chamber.

If the wastepipe is removable, take it out; scour with cloth or brush. Pour boiling water through. Thoroughly clean the trap and replace.

If the wastepipe be fixed, a small brush or swab on a wire or rattan handle may be used for scouring. Then scald with strong boiling-hot soda or borax water.

Replace the racks and ice.

Replace all shelves and the food.

See that all dishes are clean on the outside.

Be sure all doors are shut tightly and the outside wiped with a damp cloth or washed and wiped dry.

Scrub the water pan. Scald and replace.

The food chamber may, of course, need cleaning oftener than the ice compartment.

CHAMBER CARE

At least one-third of our lives should be spent in sleep and the care of the room where sleep is obtained is certainly next to if not equally important to the care of rooms devoted to the preparation, serving or storage of food materials and utensils.

Such care includes the daily chamberwork, but is more than that as it is commonly understood.

We have already decided that during the night the body shall not be poisoned by breathing impure air. However, it is all the time polluting the air and the bed furnishings by respiration products, by perspiration and by the dead cells cast off from the body.

Then, in the sleeping rooms, there is often much soiled water from the bath and, worst of all, may be, the urine voided during the night. Not only is this last waste most liable to putrefaction because it represents the nitrogenous waste, but it has been proved that in it may be the germs of typhoid fever. These may retain their vitality for a long time after convalescence has begun or even after health is regained.

In addition to all these, there is much dust thrown into the air by the process of bedmaking. (See *Household Bacteriology*. Fig. 48.)

We have departed far from the ideal bedroom which was simply the place for a bed, not a bathing, dressing, sewing or living room as many sleeping rooms are. However, when one room serves many purposes it

means that more care and labor are necessary to keep it in proper condition.

Therefore the greatest emphasis should be paid to cleanness in all sleeping rooms. This means much more than ordinarily clean bedding. It means first of all floods of clean air (sunshine as much as possible). This clean air should be stored in the bed itself of whatever form it may be, among all its coverings, as well as in the closet and the room.

Efficient ventilation, as we have seen elsewhere, means that dirty air must be let out before clean air can replace it. The sun may well shine on the bed itself and all parts of the bed should be bathed in clean air.

Every child, boy as well as girl, should be taught to open the bed as soon as possible after it is left.

Ideally every covering should be taken off separately and spread out by itself. This would be impossible in many rooms, but the first part should be done.

Let each covering be taken up away from its lower neighbor. This lets the heated, impure air escape and the fresh air will take its place more thoroughly.

If the bed is left unopened, except where the occupant got out, and is made up again without further opening, unclean conditions must follow. The odors from such a bed are sufficient proof of uncleanness.

When a mattress rests on an open spring it is bathed in air on both sides. If it lies on an upholstered spring, the mattress should be raised and the air allowed to

circulate about the underside. The pillow, if it is filled with feathers, should be stirred up thoroughly that the air enclosed may be driven out and replaced by clean air.

Our grandmothers made their beds and pillows with a goose quill sewed into the corner and thus secured a *ventilating flue*. Why is it not as necessary now as then? Some manufacturers do put in a rubber tube, but more pillows have not this simple direct means of keeping the pillow both fluffy, sweet and clean.

A hair pillow is less difficult to keep fresh, while the air pillow may be emptied and refilled as desired.

The opened beds should air a long time, remembering that the least time to be thought of is one hour. It was a skillful physician who said, "If I could have my way, no bed in my house should be made until night."

Compare his standard of clean, healthful beds with that of the women who make their beds before leaving their rooms, or with the houses where all beds must be made by the time the breakfast is finished. Some housewives who are fortunate enough to have a covered balcony which can be used for the purpose, let the bed-covering hang in the sun all day. They should be taken in while the sun is shining on them, not left out to become damp, as the air cools.

Too often the foot of the bed is not sufficiently opened, and normally, from the feet of all persons,

there is given off much waste matter. Here, too, abnormal conditions result in highly decomposable and odorous wastes.

Mattresses should be turned often. For a double bed, therefore, a two-part mattress is the best form to buy.

Any closet needs careful ventilation, especially the one in a sleeping room. Some persons always leave it open during the night. If this is not done, or even if it is, the door should be open while the room is being sunned and aired.

All urine and dirty bath water should be removed from the room as soon as possible. Ideally this should be done before the room is left to air. If not, this should be attended to first in the chamberwork.

As bedmaking is necessarily a dust-spreading process, the rooms will be much cleaner if the chamber work can be done thus far in each room, then the dust will have some time to settle. Then each room may be dusted in succession in the same order in which the beds were made.

The common cry, "I dusted this morning thoroughly, but now you would never know it," is seldom heard when the chamberwork is divided in this way.

If each room must be finished by itself, then the bed should be made first, that the dust may settle as long a time as possible. The troublesome fluff, which is chiefly lint, but which is laden with dust, is much lessened where the floor is wiped with a damp or oiled cloth.

The bed frame, spring, and mattress should be kept clean from dust as a preventive measure against insect pests.

The metal beds are cold, hard, non-absorbent, and therefore not as favorable for insects. But they are made with joints where the troublesome bedbug may hide and lay its almost invisible egg. Any metal or wooden bed wiped over occasionally with a cloth dampened with a few drops of kerosene will be much less liable to serve as a breeding place and when rubbed dry for a polish, its appearance will also be improved.

THE WATER CLOSET

No careful housewife thinks of neglecting to wash out the chamber when she does her chamberwork. Yet there are many who never do more than flush the closet, which perhaps receives all the human wastes of the house. Would these women think the chambers could be kept always pure and sweet by a mere rinse of cold water?

Every closet needs careful daily attention if not a daily thorough scrubbing. It is usually best to do this at the end of the chamberwork.

There are many ways in which this may be easily done. The following is a good method:

Raise the seat.

Flush generously.

Put into the bowl a handful of strong soap powder, or sal-soda. Let the bowl soak while other work is being done.

Then take a regular water closet brush, a swab or
and scrub all parts which can
the trap as far as possible.

1. Location & construction.

2. Decoration

3. Methods of heating
+ ventilation

4 - Sleeping porches

5 - Spec. arrangements & hygienic work, not forget-

(1) Kitchen

(2) Dining room

(3) Pantry

8 5 11
6 5 1
9
6 6

fine scouring soap which
the table dishes may be
rim, and all parts inside
in place of soap and

water, if not removed
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possible. Especially is this difficult with stairs. The

natural currents of the house tend to carry the dust upward and too often this means that the stairs above get most of the dirt which is removed from those below.

With bare stairs, there should be no sweeping with a stiff broom, but thorough dusting. Occasionally a soft brush may be needed to collect mineral and other coarse dirt. However, brushing should be avoided whenever a cloth will answer, for a brush necessarily raises some dust which will settle back, while a damp or oiled cloth will take up the dust on itself.

Stairs carpeted through the middle are easier to clean because there are fewer corners and angles than where the carpet covers the entire stair. On the carpet use a damp whisk broom. Dampened pieces of paper may be scattered over the tread, if desired.

Take a half sheet of newspaper. Wet and place a straight edge just back of the front edge of the dustpan. Cover the pan and double the surplus paper under just enough to make it stand well up at back and sides. This will serve to catch the dust as it is thrown by the broom. Place this dustpan under the edge of the stair. Sweep the dirt from each stair directly into the pan, in this order,—riser, angle, tread. Always run the brush along the edge of the carpet for considerable lint often collects here. After the dust has settled, the carpet should be dusted with a damp cloth. When the margin is dusted the cloth should be run under the carpet as far as possible. Any carpet collects dust

and on stairs every footfall acts like a pair of bellows, thus blowing out the dust from beneath. If as much of this as can be reached is removed at every cleaning, much less dust will be seen on the margin and the carpet will wear longer without removal.

The rule, "sweep from the walls," holds good with the all-over carpeted stair, but the stroke should be a curved one toward the dust-pan. On the bare stairs a painter's round brush is a convenient implement to reach into the corners for the dust which invariably lurks there. If this is not removed each time, a wooden skewer or a blunt stick under a cloth will probably be necessary in a short time to dig out the corners.

Time and strength should be considered when stairs are dusted, and all adjacent or related parts should be cared for as reached. For example, the baseboard on one side, the banisters and hand rail on the other and also the lighting fixtures, pictures, etc. Just how long a time should elapse between sweeping and dusting no one can say, but the more the dust is scattered the longer the time necessary for it to settle, that the more can be removed.

We have found already so many objections to rough, uneven surfaces that we certainly may appreciate the need of ridding the house of such bacteria-harbors. Cracks and holes are unsightly, not only catch and store dirt but also this dirt collects moisture if any is present; then mold may grow, or, if the dust remains dry, insects—flies, moths, fleas, etc.—may hatch there

and infest the house and its furnishings. Cracks should be filled. Putty, plaster of paris, sawdust and glue are all good fillers for cracks of different sizes and in different places. Any of them may in time wear out and need renewal. Very thick paint is a good filler.

Putty is whiting mixed with linseed oil. If applied to unfinished wood the inner surfaces of the crack or hole should first be touched with shellac. If this is not done the oil from the putty will be absorbed and make a visible darker line or ring. Perhaps wax is better.

By the "handy man," or boy, or by the woman who can use a few tools fairly well, large cracks can better be filled with small wedges of wood driven in tightly. These may be so well fitted and matched in color that they are not noticed. The fact should ever be kept in mind that "a crack is an abomination" because of its ability to store filth. In kitchens and pantries it is often true, as was laconically said by the superintendent of a large restaurant noted for its cleanness, "A crack means a cockroach." Too often in bedsteads or in the sleeping rooms a crack is an invitation for that "flat patterned time keeper" of which Dr. Holmes spoke, but which is in common speech, the bedbug.

Cracks and holes in pantries, food storage rooms, etc., often furnish nesting places for ants.

They, too, make it easier for mice to enter such places.

These few methods are surely sufficient to indicate the important parts of a house to be studied carefully by the progressive, sanitary housewife.

There is no *one* method which is best for all, therefore let each student make her room, her house, or some other building over which she may have control, her laboratory, in which she may experiment. When she finds a good method for her conditions let her keep to it until a better one presents itself. Perhaps the following notes may suggest the better way.

NOTES

From among the hundreds of tests returned by the students in Household Hygiene there are many suggestive illustrations of the principles set forth in each subject. A few of these from widely separated portions of the country seem to be of common interest.

This appendix will partly supply the need of Mrs. S., who asks: "Are there any printed reports of the different tests or any way of knowing the ideas of others taking the same course?"

A sleeping room is described as situated on the ground floor with one window opening into a partially enclosed space largely occupied by sewage-soaked earth from the sink drain. If other rooms are similarly located no wonder, as L. P. says, "It is not strange that there is not one healthy person in the family."

From the deck of a houseboat on the Mississippi during a trip of 1,200 miles, one writes: "I do not know where in New York you will get as healthy surroundings save in another houseboat. Our hold (cel-

lar) was whitewashed, our every room was flooded with sunshine some part of the day. All refuse went over the side into the swift current."

"Most people have some fad in sanitation, but as a whole they are all more or less careless. Some will insist on open windows in sleeping rooms but seem to mind nothing about the outside surroundings. Some take no care of the cellar but are all right as far as living rooms go. Some are more than particular of what they eat but think nothing of what they breathe."

Mrs. R., wife of the principal of an agricultural college, says: "If made land is from good soil and is ploughed and harrowed in order to carry air into it to purify it, it is healthful."

"In flat prairie soil, suit the system of drainage to the site, using drain tile, as the tile conducts the water quickly even when the fall is only a few inches.

"Sometimes when there is no other outlet, two barrels are sunk in the ground one on top of the other and filled with broken rock and the tile empties into this at some distance from the house and below frost line. If first-class tile are laid they will last a lifetime."

"In this country there are no cellars, unless one excepts the caves which consist of only one excavation cemented, with a small trap door. Primarily they are cyclone caves tho' some store a few fruits in them. All have a ventilating flue."

How a damp cellar was made dry. City house, one of a row. Main sewer ran through street. Site, made land:

"Coming in of tides and in stormy weather sewer water would back up in the pipe and break through the hardest concrete that could be obtained and would flood the cellar perhaps two feet deep with sewer water."

At last "owner dug a trench around the entire cellar inside, filled it with small stone, bricked up a wall one foot high and 6 inches wide around the trench and cemented the whole over with concrete. It has stood seven years without a drop of water in the cellar."

"Cellar walls: whitewash with enough copperas to color it yellow.

"Kitchen and bath room walls, oilcloth.

"They are all cheaply and easily renovated."

Miss S., Long Beach, Cal.: "In Los Angeles the sea breeze comes directly from the south, as on account of a sharp curve of the coast the sea at its nearest point is exactly south of the city. The streets are laid out diagonally—there is hardly a street that is not diagonal. . . . The city history states that the streets were laid out in that way for the purpose of letting every street and house get the sun at some part of the day.

"The soil here generally is about as hard as a rock and perfectly dry most of the year, unless irrigated. No cellars."

Mrs. G. says: "I understand that the city of Denver is laid out on 'the bias.'"

"I have seen, in the South, brick houses with green

mold on the bricks, nearly up to the windows, showing plainly how far they had drawn up the moisture."

"Few people believe that the best is the cheapest either for tenants or for themselves. They put their money into carpets, upholstered furniture, silken hangings like kings who have numerous servants. Few of us care to be plain people in America and try to do with one maid what ought to take several to attend to. Long ago I cut the superfluities out, and can do my own work,—but my kind is not numerous in our large cities."

Mrs. W. says: "I have gone over my house, which is very far from being a curio shop, and have removed all 'Superfluity of naughtiness.'"

In this way she hopes, no doubt, to keep her house some distance above the "diphtheria line."

"No unnecessary ornaments—merely dust collectors, etc. . . . Dispose of them and train the eye to simplicity and healthful emptiness."

Mrs. E. G. B. says she has been trying to persuade her brother, who was building a house, to lay all his floors in hard woods, "but he insists upon carpets in some of the rooms. It seems to me that men are rather inclined toward thick carpets with rugs on top of them, if possible."

Yea! Verily! But if they had to clean and dust such rooms how quickly they would change all this!

"A well-aired room really looks larger."

An interesting experiment is outlined by Mrs. F.

She uses a gas range and when the chimney was built over she told the mason how she wished the flue built. He *obeyed*, and "It works all right."

She had a hood opening by a hole into the chimney. High up under the hood she had another hole cut into the chimney. This is lined with pressed brick and faced with the same. The space is large enough to hold a good sized lamp which soon heats the flue and insures perfect circulation. "It carries off more steam and smoke than the hood flue." She intends sometime to have this hole lined with looking glass so as to have her stove lighted by the reflected light.

Evidently there are women who can invent household conveniences on scientific lines!

That all knowledge does not belong to the scientifically trained, but may be possessed by others through experience, is shown by the report of Mrs. S., of Maine:

"We have an earth closet at a camp. The closet has always been a great source of annoyance on account of the horrible odors of the deodorants we felt obliged to use. My mother, too gentle to insist on old-fashioned ideas in the face of modern knowledge, has repeatedly told us that when she was young, fresh earth was considered the very best thing."

"At one time in a certain section of Los Angeles the vegetable gardens which supplied the markets of Long Beach were irrigated with sewage-polluted water. There were so many cases of typhoid fever

traced to this source that it is now made a criminal offense to use sewage waters for irrigation in any market gardens for vegetables eaten raw."

Miss R. writes that she has been much interested in the waste disposal of a friend's house at W. It is accomplished by means of a septic tank, which she describes. She saw "the drawings and as much of the tank as there is to see which is really nothing."

The tank is lined with cement throughout—top, bottom and sides. The inlet is at the side. This receiving tank overflows into a smaller tank which empties itself automatically by siphonage through tile drain pipe "so laid that the effluent can ooze out between the joints." Each tank has a manhole, but both are covered over with earth. Near the inlet the first tank has a vent pipe which extends about a foot above ground. At the time of examination no trace of odor was detected.

A cautious woman, who had never found aught wrong with her plumbing, and whose husband was a member of a State Board of Health, became so wrought up after her study of "plumbing" that she sent for an expert to test her plumbing system. After an hour's work he came to her with a puzzled expression and said that he could find no defect whatever, but if she would tell him exactly where she smelled the sewer gas "and I was forced to explain that I had not yet smelled the sewer gas but was simply animated with a strong fear that I should. He

left promptly with an expression of righteous indignation on his face."

However, assurance of safety is usually worth its price, but she might have made the "peppermint test" herself with less expense.

Miss W. uses a cloth moistened with "one third kerosene" and "two thirds lard." After dusting, the furniture "is dried with a flannel."

"Vaporized pure formaldehyde with a little glycerine added to prevent the white crystals from remaining in the pan after boiling proved very effective as a disinfectant for us," writes Mrs. S.

An uncommon type of furnace is described by Mrs. F. of Rockford, Ills., who says: "I really can do all that I claim with it."

The pure air from out of doors is heated as in any other type of furnace and the warmed air circulates through the different rooms.

Around the smoke pipe is another pipe, opening like the smoke pipe into the chimney, which expands at its lower end into a box surrounding the warm-air duct but entirely separate from it.

She says that through the holes in the outer compartment of the register the foul air of the room is sucked in, heated by contact with the smoke pipe, then carried into the chimney. Inside this "foul air" pipe are check valves in the shape of little doors which swing up only, thus allowing the air to pass upward into the chimney but never downward.

A feather held "over the center of the register is blown up, but within a number of feet of the outside circle of the register it will be drawn down and into the outer box, so that I have to take the dust and lint out of that box very frequently."

She bears testimony to the ventilating efficiency of this combined inlet and outlet furnace in these words: "I live on a farm and we employ much outside help which we must board and they are usually foreigners. My family often numbers fifteen. . . . One of the worst duties used to be the work in the men's rooms—the air would be so foul that I would rush in, throw open the windows and wait until late in the afternoon before making up the beds." Since the furnace was put in seven years ago she finds that the air is continually changing and by the time "I am ready to go upstairs I can make up the beds and put the rooms in order without discomfort."

The furnace is a large one and heats eleven rooms averaging 15 x 15, besides halls, bathrooms, etc. They burn the dead trees from their own wood lot and keep a very even heat.

A student writes: "In our bath room a draft from an open window on a zero day passed two cold water pipes of the same size as the hot water pipe which *froze* and burst, although there was a good fire in the furnace of the system directly under the bath room. Nothing else froze."

Water which has lost its dissolved air by being

heated will freeze (and boil) more quickly than ordinary water because without the air it becomes a better conductor of heat.

Mrs. E., of Washington, D. C., has an ingenious son who suggested the following scheme: "A dark stairway is now brightly lighted by means of a mirror which was placed so as to catch and reflect the light from a distant window."

One student has "known an eight-candle power electric light to set the casing on fire from hanging in direct contact with the wood."

Miss S. has found that even ice from artesian wells which might be considered above suspicion "leaves a sediment on melting and what this may contain we can not tell except on analysis."

In Butte, Montana, Mrs. A. says, the old tinned cans are collected and sold to the men at the copper mines. They are allowed to lie in the copper-saturated water. The copper is precipitated and in time the iron becomes almost "solid copper."

That the average woman is quick to apply scientific knowledge when such applications affect the home is amply proved by the constant replies which are returned in the tests.

The following are only a few from among the many lessons which have been acknowledged.

"Dozens of things come to me as I go about the house each day."

"The course has taught me the whys and where-

fores of so many everyday duties which before had been, perhaps, just as well performed, but blindly done and so much pleasure lost.

"There is such pleasure in keeping house for it is such a live occupation. There is always so much to learn, so many new fields to conquer."

"I feel a growing sense of order and mastery of my work and what is helping me most just now, as the spring cleaning is going on, is the lesson that things should be kept in use or destroyed and not stored except for good reasons."

"I appreciate the importance of cleanness in the house, the methods of cleaning, the necessity for properly cleaning and cooking food and, greatest of all, the dangers that arise from carelessness in the care of disease of any kind."

"Here, in Washington, one crying condition is the damp cellars made more damp and unsanitary by exclusion of light and air."

"Even in well-regulated households there is too great a leaning toward closed windows, closed blinds and drawn shades."

"I best preface my answer with 'Let him who thinketh he standeth take heed lest he fall.' If my small knowledge of sanitation has before been negative I think I can truly say it is now positive."

"I haven't any house of my own to practice on now, but I expect to make my friends' lives wretched by airing off my superior knowledge!"

"The necessity of cleanliness in water supplies, gas fixtures and lamps, furnace intake and ducts has been brought home in a most forcible way that I shall *never forget*."

"I regret I am concluding my papers in Household Hygiene—like Alexander the Great, I am sighing for more worlds—hygienic—to conquer."

"I have been studying the matter of letting rooms stand for dust to settle. If swept early before breakfast in summer I should think it might be managed. When it is possible to dust the furniture and put it out of the room before sweeping, it seems to me, it would be a good thing, saving time in putting to rights afterwards. It is in the crowded city where there isn't an inch of extra space, often no sunshine and but little air, where the problems of housekeeping seem insufferable."

Miss A. puts "the curtains up higher" and keeps "them up longer."

"My school room has undergone a process of elimination. Sundry dust-gathering decorations have come down and my endeavor is for airiness and cleanliness rather than for display."

"Burlap is expensive for wall coverings, but it can be washed with soap and water."

A doctor's wife expresses her enthusiasm thus: "I have always liked housework with the esthetic side of my nature now I am beginning to have glimmerings of an intellectual pleasure in it."

Mrs. M. says: "Although I am a very busy woman I feel that I should take more time for these studies since they are well worth it and 'If a thing is worth doing at all, it is worth doing well.' So I shall make a more determined effort for time to study and think."

Mrs. D. says: "I believe if our houses were easily kept clean, all things arranged to assist cleanliness, as light, airy rooms, plenty of light and sun, and furnishings simple and wholesome, that one-half the domestic problem would solve itself as our maids like better to see things clean and fresh, if only things are made comparatively easy for them."

"I wish every wife, mother and homemaker could and would have the advantage of this course of study. Scarcely an hour passes in the day when the practical importance of the lessons is not brought to my mind."

Miss B. says: "She must learn and teach her pupils as children to take the right kind of interest in their surroundings—not to do their work 'any old way' just to get through, but to work intelligently and to enjoy what they do; to get something out of life by putting themselves into it."

It is almost an axiom that we get no more out of any subject than the amount of energy we put into it.

"Among the splendid lessons I have learned, 'tis difficult for me to select one and call it most valuable, but I believe after considering the whole scope of the study, the fact which has dawned upon me—viz., that in strict hygienic living lies the secret to less doctors,

less miserable, unhappy men and women, less chronic complaining—in short, the secret to the conviction that life is a beautiful trust, well worth the living, this fact to me constitutes the most valuable lesson I think I've learned.

"To improve conditions in many cases one would have to destroy to the ground. People do not seem to care. They look on one as a crank who insists on improvements. In New Orleans I asked several why they did not put wire over their cisterns—the almost only water supply to the houses. They said, 'Oh, we get on nicely without. There will be so many mosquitoes anyway.'"

Sometimes these lessons of prevention are learned by severe experience through the diseases which they cause. Mrs. W. writes: "I was very ill when I wrote the examination, . . . I am only just able to take up my life again. My illness taught me many things concerning disease germs, thorough sterilization, etc."

Miss Alice Ravenhill, of England, in her report to the Technical Instruction Committee, says that the motive actuating all efforts is or should be the attainment of good health for the individual and the community, as well as the dignifying and development of home life.

Miss Clarke, of the Thomas Clarkson School of Technology has thus enlarged upon the needs and aims of the study of health and closely connecting

problems: "It is just as important for good citizenship that the child should be taught the rules governing sound health as that he should learn the rules of arithmetic. . . .

"A part of the common racial knowledge should be an understanding of the essentials of healthful living in order that the highest attainment of human progress may result. Individuals should be so educated in public and personal hygiene and sanitation that they will cheerfully support the city or state in enforcing sanitary measures.

"When public opinion is so educated, cities will be held responsible for the purity of air in public buildings and schools, the purity of foods sold in stores and the healthful, cleanly conditions of their thoroughfares. Schools and colleges will then be required, also, to look after the bodies of their pupils as well as their minds. They will lay as much stress on having pure air, food and surroundings as they now do on having well-equipped laboratories or libraries."

Miss G. says: "I have a decided interest in the School as one of the agencies to help us women to have more intelligently conducted, healthier, sweeter, and happier homes. Comparatively few of us have had wise, all-round, up-to-date training in cooking, laundering, marketing, sanitation, and care of ourselves, our houses, children and invalids, and all these in as easy and economical manner as possible. Many of us have had little practical experience, and many more

have missed or are missing knowing of great strides that the systematized knowledge, dealing with home-making has made in the last ten years. Such knowledge is rapidly creeping into schools and colleges, but too late for us—and we don't want to be left behind by school-girls."

" "We all recognize how much the comfort of a home makes for present happiness, how much its welfare contributes to the children's development and the morality of our civic life, how strong the force of example, and how great the reward to the home-maker."

**SUPPLEMENTAL PROGRAM ARRANGED FOR
CLASS STUDY ON**

HOUSEHOLD HYGIENE

By S. MARIA ELLIOTT

Instructor in Household Economics Simmons College.

- I. THE SURROUNDINGS FOR A HEALTHFUL HOUSE. ✓
- II. THE BUILDING AND FURNISHING OF A HEALTHFUL HOUSE. ✓
- III. THE SUPPLIES OF A HEALTHFUL HOUSE. ✓
- IV. THE WASTES OF A HEALTHFUL HOUSE. ✓
- V. METHODS OF PREVENTION, REMOVAL, AND DISINFECTATION IN A HEALTHFUL HOUSE. ✓
- VI. THE PUBLIC HEALTH.

Each topic is divided into two or more sections; subdivide among different members as desired.

The books mentioned for advanced or extended reading should be found in any public library. If not available they may be borrowed from the School as needed.

Perform as many of the experiments suggested as possible or originate better ones.

MEETING I

(a) Surroundings (Study pages 1-15)

Examine the surroundings of some house for a radius of ten feet; fifty feet; a quarter mile beyond this.

Consult contractors of the section for facts concerning character of the soil, dip of strata, height of ground water, etc.

Test the rapidity of absorption with different samples of soil.

Also test their ability to drain away the water.

Try the experiments outlined on pages 8-9.

Have some holes dug near cellar wall or elsewhere at varying depths to note the character of the soil. At the same time note condition of cellar wall under the ground surface.

Lay a miniature drain of clay pipe stems in wet earth, noting how water will ooze between the joints.

References: Read the Sanitation of a Country House, by H. B. Bashore, Chapters I and II. (\$1.00, postage 10c.)

Healthy Foundations for Houses, Glenn Brown. (50c., postage 4c.)

Outlines of Rural Hygiene, by H. B. Bashore. Chapters III, IV. (75c, postage 6c.)

Home Sanitation, by Richards and Talbot. Chapter VIII. (25c., postage 4c.)

(b) Cellars (Study pages 16-28)

Inspect some cellars or foundations in process of building.

Sketch points of compass and the axes of several houses having different relations to the above. Compare the time during which some one room receives sunshine for one week, in each of these houses.

Keep these plans and make additions during the following months of the year.

Have each member sketch her idea of a kitchen and dining room with their related parts, such as pantries, store rooms, china closets, cellar stairs, etc.

Indicate best position of stove, sink, table, refrigerator, etc., for light, convenience of work, saving of steps, etc.

References: Read Home Sanitation, by Richards and Talbot. Chapters I, II, IV. (25c., postage 4c.)

Use the questions in Chapters II and IV as the basis of a personal inspection of some house.

Home Economics, by M Parloa. Chapter I. (\$1.50, postage 16c.)

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MEETING II

(a) Ventilation (Study pages 29-46)

Study the currents of air in different rooms with different systems of heating, using a candle flame, pitch pine knot, torch, incense stick; or watch the smoke from a cigar.

References: Read Home Sanitation, Chapters V, VI, using questions as before suggested. (25c., postage 4c.)

The Care of a House, by T. M. Clark. Chapters IV, V. (\$1.50, postage 14c.)

(Select answers to Test Questions on Part I and send to the School and report on Supplemental Work.)

(b) Heating (Study pages 47-73)

Have all who can tend or supervise the fire and regulate some system of heating for one week. During this time experiment with the ventilation and heat, noting conditions under which most favorable results are obtained.

Compare results of same system of heating, as warm air furnace, in different houses.

References: Consult Home Economics, by M. Parloa. Pages 134-147. (\$1.50, postage 6c.)

The Care of a House, by T. M. Clark. Chapters VI, VII. (\$1.50, postage 14c.)

MEETING III

(a) Lighting (Study pages 74-90)

Note the reading of a thermometer in the room.

Hold bulb of the above under shade of a large lamp or near globe of gas fixture, for five minutes or longer.

Note the difference in reading.

Change the thermometer to other positions near source of light and note reading.

Try the effect of white paper, black or dark colored paper, cloth, plush, velvet, etc., under a lamp, to show amount of reflected or absorbed light.

Arrange the window shades at different heights to see where room is most agreeably as well as thoroughly lighted. Try a shade rolling up from the bottom.

Experiment with clear and opalescent glass over flame. Cheese cloth of different tints may be used over the clear glass to simulate the effect of different shades.

References: Read Gas Lighting and Gas Fitting, by Wm. Paul Gerhard, pages 7-132. (50c., postage 4c.)

The Care of a House, by T. M. Clark. Chapter X, XI. (\$1.50, postage 14c)

(b) Water Supply (Study pages 91-113)

Try the effects of the following as a strainer for water from pump or faucet—a cheese-cloth bag, a flannel bag, either of these with coarse sand or with pulverized charcoal. Collect a bottle of the water which has run through each of these. Compare their appearance.

Cork tightly and keep in a warm place. At the end of a week, compare the looks, odor, taste, etc., with a sample of the same amount which has not been strained.

Boil a quart of water fifteen minutes. Pour into a hot fruit can and seal. Repeat the same leaving the can open. Compare the taste of the two at the end of 24 hours.

Perform the experiments outlined on page 111.

References: Read The Sanitation of a Country House, by H. B. Bashore. Chapter III, V. (\$1.00, postage 10c)

Rural Hygiene, by H. B. Bashore. Chapter I. (75c., postage 6c.)

Water and Ice, by T. M. Prudden. (75c., postage 10c.)

The Care of a House, by T. M. Clark. Chapter VIII, IX. (\$1.50, postage 16c.)

Home Economics, by M. Parloa. Chapter II. (\$1.50, postage 16c.)

(Send answers to Test Questions on Part II, and give reports of experiments performed.)

MEETING IV

(a) **Wastes of the House** (Study pages 115-127)

Get a copy of, or look up, the laws of the city or town concerning the division, collection, etc., of wastes.

In own house, inspect carefully the systems of disposal of each class of wastes. See if any improvements can be made.

Unless the food wastes are used for animals or as a fertilizer, experiment with burning the garbage for one week.

Could the garbage pail be eliminated? If so, what methods will best take its place.

References: The Disposal of Household Wastes, by Wm. Paul Gerhard. (50c., postage 4c.)

The Sanitation of a Country House, by H. B. Bashore. Chapter IV. (\$1.00, postage 10c.)

Outlines of Rural Hygiene, by H. B. Bashore. Chapters II and V. (25c., postage 4c.)

(b) **Water Carriage Systems** (Study pages 128-151.)

Make a sketch of the drainage plumbing of some house.

Compare these sketches.

Try the peppermint test if feasible.

References: House Drainage and Sanitary Plumbing, by Wm. Paul Gerhard. (50c., postage 4c.)

How to Drain a House, by Geo. E. Waring. Chapters I, II, III. (\$1.25, postage 12c.)

Home Sanitation, by Richards and Talbot. Chapter III. (25c., postage 4c.)

MEETING V**(a) Care and Cleaning** (Study pages 152-164)

Reports of personal methods of house care.

Assign at least one of the suggested methods to be tried and reported upon at next meeting. Consider advantages and disadvantages of each process of ordinary house care, in relation to time, strength, sequence of the several parts and their connections with each other.

References: Home Sanitation. Chapter VII, as before suggested. (25c., postage 4c.)
The Care of a House, by T. M. Clark. Chapter XII, XIII. (\$1.50, postage 10c.)
Home Economics. Chapter IV, V, VI, VII, VIII, XII, XIII, XV, XVI as applicable.
The Healthful Farm House, Dodd. (60c, postage 6c.)

(b) Methods and Results (Study the Appendix)

Reports from trials of these methods.

Assign members to report upon the "housekeeping" or care given to school houses, churches, or other public buildings.

Assign "Disinfection and Disinfectants," by Milton J. Rosenau, pages 17-47; 83-93; 112-127; 154-174; 248-344, among the members to be reported upon.

References: Read A Guide to Sanitary House Inspection by Wm. Paul Gerhard. (\$1.00, postage 10c.)
Home Sanitation, by Richards and Talbot. Chapter IX, X. (25c., postage 4c.)

(Select answers to the Test Questions on Part III. Also send reports of trials of methods given in the text and give suggestions for better ones.)

MEETING VI

(a) Municipal Housekeeping

Get a member of the local Board of Health to give an account of his duties and describe the methods of disinfection for the several infectious diseases.

Report on the source and care of the local water supply.

Report on the drainage system.

Report on the conditions of the dairies furnishing the local milk supply.

Report on the condition in markets, groceries, bakeries, laundries.

Report on the condition of local slaughter-houses.

(b) State and National Public Health

Read "Public Health in the United States" in Personal Hygiene, Vol. VIII.

Send to the capital city of your state and ask the Secretary of the Board of Health to send all literature available, including the last yearly report.

If possible get a member of the State Board of Health to tell what is already being done to advance the public health in your state and what more the Board would like to do if it had sufficient appropriation.

Collect a library of U. S. Bulletins bearing upon Bacteriology, Hygiene, and Sanitation.

Ask your senator to request the United States Department of Health and Marine Hospital Service to send their last yearly report.

The United States Department of Public Health has no popular publications similar in character to the Farmer's Bulletins on food, etc., of the Department of Agriculture.

If it seems advisable, send the following resolution to your senator and congressman:

Whereas, living men are the most valuable possession of the state, as health is of the individual; and

Whereas, the health of the people must depend ultimately on the education of the individual; and

Whereas, over 300,000 deaths occur annually in the United States and a vast amount of illness results from contagious and infectious diseases, now known to be preventable,

Resolved, that the Congress is hereby petitioned to authorize the Department of Public Health and Marine Hospital Service to issue a series of bulletins, popular in character, for free distribution throughout the United States, on the various preventable diseases, as consumption, pneumonia, diphtheria, typhoid fever, meningitis, scarlet fever, whooping cough, measles, etc., on disinfection and other health matters.

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Remember!

THAT ten billions of dollars are expended annually in the United States for food, clothing, and shelter—with greater knowledge and efficiency, better satisfaction could be obtained and one billion dollars saved for higher things.

THAT half a million lives are cut short and five million people are made ill by “preventable” diseases every year—with universal knowledge of hygiene and sanitation nearly all deaths and illness from such causes could be prevented.

THAT six hundred thousand infants under two years end their little span of life yearly, while millions of children fail to reach their best physical development because their mothers and fathers understand not how to care for them in the light of science—with more knowledge at least half the number of babies could be saved and the physical standard raised immeasurably.

THAT thousands of homes are wrecked, tens of thousands of lives are ruined, and hundreds of thousands are made unhappy because the home-keepers of our country have no training in the greatest of all professions, the “profession of home-making and motherhood”—only through such education can present domestic difficulties be solved and the modern home contribute all that it should to happiness and well being.

THAT all must live in some sort of a home—that everyone finds his chief happiness there—that character is developed there—that no great advance, spiritual or material, is possible which does not begin with the home—that the home-makers of America have the making of the nation.

THAT on the breadth and strength of the base depends the height of a pinnacle—on the home foundation we rear the pinnacle of all that is good in state or individual.

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